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THE
CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE:

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.

VOLUME IX.—1864.

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ADDRESS TO OUR READERS.

On commencing a new year and a new volume, we may be excused for printing once more a short statement of our aims and objects. The Chemical News was started four years ago, with the purpose of supplying the chemist with the earliest information on the results of laboratory investigations in pure science; the technical chemist with the practical applications of the science to his various occupations; and the medical profession and pharmaceutists with every novelty of interest relating to the materia medica, toxicology, and pharmacy. These are the objects we shall still keep in view, and steadily pursue. All the information of importance we can collect from European and American sources will be regularly supplied; original researches, and articles on matters which may attract particular attention, will be frequently published; reports of the proceedings of such scientific societies as possess especial interest to the chemist will receive the earliest insertion, and works relating to chemistry an early notice. Specifications of all patents in applied chemistry will be reviewed as soon as they are made public. In this way we hope to keep our subscribers *au courant* with the progress of pure and industrial chemistry all over the world.

In like manner we seek to afford the pharmaceutical chemist and druggist every information necessary to assist him in the practical and scientific prosecution of his occupation. Nor are the political interests of the profession altogether overlooked or neglected. The Chemical News is the organ of no society, and is, therefore, free to urge reform wherever it may appear needed, and to encourage every effort to promote the general interest.

The present year will be fraught with interest to the chemist and druggist. A national Pharmacopœia is about to appear of more important a character than any which has issued from the College of Physicians. This work will receive our earliest attention. Again, the rights of chemists and druggists are seriously threatened; and it will be necessary for the majority to combine in order to defeat any attempt of the Medical Council to deprive them of their privileges, as well as to secure the exemption from serving on juries, which has already been conceded to a section. To promote these objects we shall render every possible aid.

The thorough organisation of the trade should be completed as early as possible, and the machinery is fortunately ready by which this can be effected. The United Society of Chemists and Druggists offers the means by which the entire body may operate in concert. We say this in no spirit of opposition to the Pharmaceutical Society. That society voluntarily closed its doors to the majority of the trade some years ago, and now can be in nowise astonished that, at the present crisis, some other organisation should be found necessary.

But it must never be forgotten that the occupation of a chemist and druggist has a scientific as well as a commercial aspect; and we are glad to have the opportunity of recommending to our readers an organisation which has for its object "the encouragement of pharmaceutical research." The British Pharmaceutical Conference offers the means by which every one who will interest himself in the improvement of pharmacy can be brought into communication with others similarly disposed, so that all may work in concert for the common good. We heartily commend the Conference to the notice of our readers. It has been organised on a thoroughly catholic basis, and has for its sole object the promotion of knowledge.

In conclusion, we may add that it is our intention to publish occasional courses of lectures, and popular papers, on different branches of the science; and it is to be hoped that our more recondite readers will look with favour on these attempts to diffuse more generally a knowledge of chemistry, and so, we hope, stimulate a desire for a more profound acquaintance.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Contributions to the History of Thallium,

by William Crookes, *F.R.S.*

Oxalate of Thallium.—This salt is readily prepared by boiling together equivalent quantities of carbonate of thallium and oxalic acid, in just sufficient water to dissolve the product when hot. Upon cooling, oxalate of thallium crystallises out in the form of small prisms, brilliantly white and lustrous. It is not very soluble in water, and is insoluble in alcohol. One hundred parts of boiling water dissolve 9·031 parts of the salt; and the same quantity of water at 60° F. dissolve 1·443 parts. One part of the oxalate, therefore, requires 11·07 parts of boiling water, and 69·27 parts of cold water to dissolve it. M. Kuhlmann has ascribed to the neutral oxalate of thallium the somewhat improbable formula, C_4TlO_8; but several closely concordant analyses have shown me that this salt has the normal constitution of neutral oxalates. The method adopted for analysis is very simple, and gives remarkably accurate results. A weighed quantity, which had been dried over sulphuric acid, was gradually heated in an air bath to an increasing temperature, the weight being taken from time to time. At 230° F. a trace of hygroscopic moisture was driven off, and the oxalate then bore a temperature of 400° F. without further change. At 480° F. it began to discolour slightly, but it was found to have lost scarcely any appreciable weight. Pure concentrated hydrochloric acid was afterwards poured over the crystals; slight heat was evolved, and in a few minutes they were converted into a porous, spongy mass of chloride. The excess of acid was evaporated off over a water bath, and the residue was heated to 400° F. for ten minutes. More hydrochloric acid was then poured on, and the evaporation and heating were repeated. This was performed until no alteration of weight took place, the final heating being in an air bath at 500° F. As oxalic acid is entirely dissipated by exposure to a temperature of 320° F., the above treatment effectually removes this acid. Many experiments have satisfied me that chloride of thallium will bear a temperature of 500° F. without any loss of weight; at a slight increase of heat the chloride suddenly fuses to a thin brown liquid, white vapours being simultaneously evolved.

Analyses conducted in the above manner gave the following percentages of metal in this salt:—

82·298
82·274
82·230
82·206

Mean 82·252

The formula C_2TlO_4 requires 82·186 per cent. The neutral oxalate of thallium has, therefore, the normal composition. It contains no water of crystallisation.

Vol. IX. No. 213.—January 2, 1864.

Binoxalate of Thallium.—Upon mixing together two equivalents of oxalic acid to one of carbonate of thallium, and boiling, the binoxalate is deposited, on cooling, in the form of large plates, having a pearly lustre. The crystals were purified and analysed in the same way as the neutral oxalate. Upon exposure for 1½ hours to a temperature of 270° F., the crystals became opaque, and were found to have lost 3·61 per cent. of water. Further heating did not increase this loss. The percentage of thallium in this dried salt was found to be 69·341. The formula C_4HTlO_8 requires 69·520 per cent. of metal.

The amount of water present in the crystallised binoxalate did not correspond in my analyses to a definite number of equivalents. The mean percentage obtained was 3·61. One equivalent of water in the binoxalate would require a loss of 2·99 per cent., whilst two equivalents of water would correspond to 5·80 per cent. The method of analysis was such as to render the probable error of manipulation insignificant; and the closely concordant results obtained in the estimating the thallium in the dried salt prove that the error was in the amount of water originally possessed by the binoxalate when taken for analysis. It had been dried for thirty-six hours over sulphuric acid, and it is not unlikely that it may have slightly effloresced. An estimation of the water of crystallisation, in a specimen taken out of the mother liquor, and merely dried by pressure between blotting paper (containing, therefore, a little free moisture), gave results corresponding to a little more than two equivalents of water. I am, therefore, justified in assuming that the formula for the crystallised binoxalate of thallium is

$$C_4HTlO_8 + 2Aq.$$

It is strongly acid to test paper, and is much more soluble than the neutral oxalate, requiring less than its own bulk of boiling water to dissolve it. At 60° F., 100 parts of water dissolve 5·338 parts of the anhydrous salt, equivalent to one part of the salt in 18·73 parts of cold water.

On Cæsium.

Separation from Rubidium.—Bunsen* has made further investigations on this rare element. He could not apply Allen's method to the preparation of pure cæsium compounds because of the small quantity of the element obtainable from the sources at his command. He discovered that cæsium could be separated from rubidium by another plan, which is as follows:—In a mixture of pure RbCl and CsCl the Cl is determined, and from its amount that of Rb is calculated. The chlorids are converted into carbonates, and to the latter salts a little more tartaric acid is added than is necessary to produce neutral tartrate of cæsium and bitartrate of rubidium. The mixture dried and pulverised is brought upon a funnel, whose neck is stopped by a small filter, and the whole is placed in an atmosphere saturated with moisture. The neutral cæsium salt deliquesces, and passes the filter, while the acid rubidium salt remains behind.

Equivalent.—The cæsium tartrate was converted into chlorid, and the latter was purified from traces of KO and LiO, which it acquired from the tartaric acid, by conversion into platin-chlorid, washing, &c. This operation was repeated six times, the salt being each time analysed. The last three results coincided very closely, and, from their average, the equivalent 132·99 was deduced, which agrees with the number obtained by Johnson and Allen, viz., 133·03, and fully authorises the use of the round number, 133, as expressing the combining proportional of this element.

Deliquescence of CsCl.—Bunsen further maintains the accuracy of his original assertion that CsCl is deliquescent. Johnson and Allen† had stated that it was "not only not deliquescent, but scarcely hygroscopic." The observations of both are entirely correct for the circumstances under which they were made. We have since observed pure CsCl to deliquesce in a few moments on an August day; while at this writing, September 24, the same specimen has been exposed all night to the air in a room with open windows, temperature 55° F., and is in appearance perfectly dry. Bunsen rightly remarks that "Johnson and Allen appear to have made their experiments in a comparatively dry atmosphere, in which, as is known, many deliquescent salts are unaltered, and, therefore, overlooked the deliquescent character of CsCl." The experiments of Johnson and Allen were made in the cloudy and foggy, but cold weather of November,—weather which is commonly designated as *damp*, but the real moistness of the atmosphere they only judged of from sensation.

CsCl much resembles urea in its hygroscopic relations, The latter substance is stated by most recent authors, including those who have had occasion to observe it especially, to be unaltered in the air. Thus Lehmann, "Physiological Chemistry;" Gorup Besanez, "Zoochemische Analyse;" Mitscherlich, "Lehrbuch;" Gerhardt, on authority of Pelouze, "Traité de Chimie Organique;" and Neubauer, "Analyse des Harns," assert that it is unchanged by exposure to the air. Gorup Besanez, "Lehrbuch der Physiologischen Chemie," 1862, states that it is "permanent in the air, but rapidly absorbs moisture." Gmelin mentions that "according to earlier statements it deliquesces in moist air." We have repeatedly observed that in very moist air urea rapidly deliquesces, though usually, except in summer weather, it is not visibly affected by atmospheric moisture.

Spectrum of Cæsium.—Johnson and Allen, in the paper above referred to, observed that "Kirchhoff and Bunsen, in the figure given by them (*Pogg. Ann.*. 1861, and *Fres. Zeitschrift für Analyt. Chemie, Heft* 1, 1862), represent eleven lines. We find without difficulty seven more lines, and observe further that some of those figured by Kirchhoff and Bunsen are not mapped in their correct position."

In relation to this, Bunsen remarks, "We regret that Messrs. Johnson and Allen appear to have neglected to make an accurate comparison of their spectrum with ours, otherwise they would have easily convinced themselves that the lines given by them agree with ours as closely as is possible; that, on the other hand, three lines are figured on our plate which do not occur at all in the cæsium spectrum. These lines have been printed on a number of lithographs by fault of the lithographer, in consequence of a misunderstood proof that was not sent to us for revision, and lie near and to the right of the lines designated by Johnson and Allen as VI., X., and XV."

Johnson and Allen could but conclude that the coloured plate in *Poggendorff's Ann.*, accompanying the paper of Kirchhoff and Bunsen, was a copy of their spectrum as far as the important, *i.e.*, the characteristic and brilliant lines were concerned. They are therefore scarcely more in fault in having "neglected to make an accurate comparison" than Kirchhoff and Bunsen are in permitting incorrect spectrum plates to be circulated. Fresenius

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* *Pogg. Ann.*, cxix., 1.

† Chemical News, vol. vii., p. 110.

uses the uncorrected chromo-lithograph in the new edition of his "Qualitative Analyse," and we have never yet had the good fortune to see the lines of this element correctly mapped on any coloured print.

Bunsen notices at length the inaccuracies of the diagram of Johnson and Allen, which, as the latter stated distinctly, was intended to give approximatively the position of the lines on Kirchhoff and Bunsen's scale, and which from the construction of the spectroscope they employed would not be exact.

The remark of Johnson and Allen that their "line II., nearly coincident with α lithium of Kirchhoff and Bunsen, and not figured by them, is as bright as their γ cæsium, our VI. (?)"—Bunsen passes over without notice. The observation is certainly not an unimportant one, for any person occupied in preparing the new alkalies is likely to be embarrassed by a line that in small instruments is practically coincident with α lithium, if it be not credited to cæsium by the authorities.

Johnson and Allen rightly state that "the yellow line VIII. is hardly less characteristic of the spectrum of pure cæsium than the two blue lines. It also is nearly as distinct as any of the green lines when sodium is not present in too large quantity, and is much more readily made out than the extreme red line δ of rubidium." This line was wanting in the original spectrum plate of Kirchhoff and Bunsen. Chemists will be glad that Bunsen has now given, in connexion with the paper we refer to, a diagram of the spectra of all the alkalies and alkaline earths, as well as of thallium, which is quite complete, and which, by following his simple directions, is readily and exactly comparable with the spectra of any instrument. In this he figures sixteen lines for cæsium.—*S. W. J., in American Journal of Science*, xxxvi., 413.

Preparation of Chloropicrin, by SAMUEL PRIESTLEY.

THIS substance, which has usually been prepared by distilling picric acid with hypochlorite of lime, may be prepared from methylic alcohol directly—a fact which establishes beyond doubt the connection of chloropicrin with the methyl series.

I succeeded in obtaining the substance in the following manner:—

Bleaching powder is introduced into a flask, with as much methylalcohol as will form a paste. After mixing the materials, the flask must be placed in a shallow basin of cold water, in order to prevent the volatilisation of the spirit by the heat disengaged.

When the chemical action has subsided, nitric acid is added carefully and by small portions at a time, allowing the action to subside each time, the flask remaining still in the water.

The whole, when dissolved, is submitted to distillation. During the distillation a gas is evolved, which burns with a green flame, and may be collected over water. It is probably chloride of methyl, but I have not examined it further. These product which collects in the receiver appears to be a mixture of chloroform, chloropicrin and wood-spirit. These substances are afterwards separated by distillation; the chloropicrin, having a higher boiling point, remains behind.

In the actual reaction it is very probable that chloroform is first produced, and that the nitric acid reacts according to the following equation:—

$$CHCl_3 + \left.\begin{matrix}H\\NO_2\end{matrix}\right\} O = CNO_2Cl_3 + \left.\begin{matrix}H\\H\end{matrix}\right\} O^*$$

The odour and oily appearance of the substance leave no doubt as to its true chemical nature.

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* Carbon = 12. Oxygen = 16.

TECHNICAL CHEMISTRY.

Account of an Oil-Lamp Furnace, for Melting Metals at a White Heat, by CHARLES GRIFFIN.

I HAVE been for some time engaged in experiments on the construction of chemical lamps. My object was to discover a method by which chemists and metallurgists, who have occasion to melt metals at a white heat, but who happen to have no command of coal-gas, may be enabled to accomplish their purpose by other agents. After many trials, I have contrived an oil-lamp which is not only as powerful in action as the best gas furnaces, but almost rivals them in handiness and economy.

Description of the Apparatus.—The oil-lamp furnace is represented in perspective by Fig. 1, and in section by Fig. 2. It consists of a wick-holder, an oil-reservoir, and a fire-clay furnace. To these must be added a blowing-machine for the supply of atmospheric air.

The oil-reservoir is represented at letter *a*. It is made of japanned tinplate, mounted on iron legs, and fitted

FIG. 1.

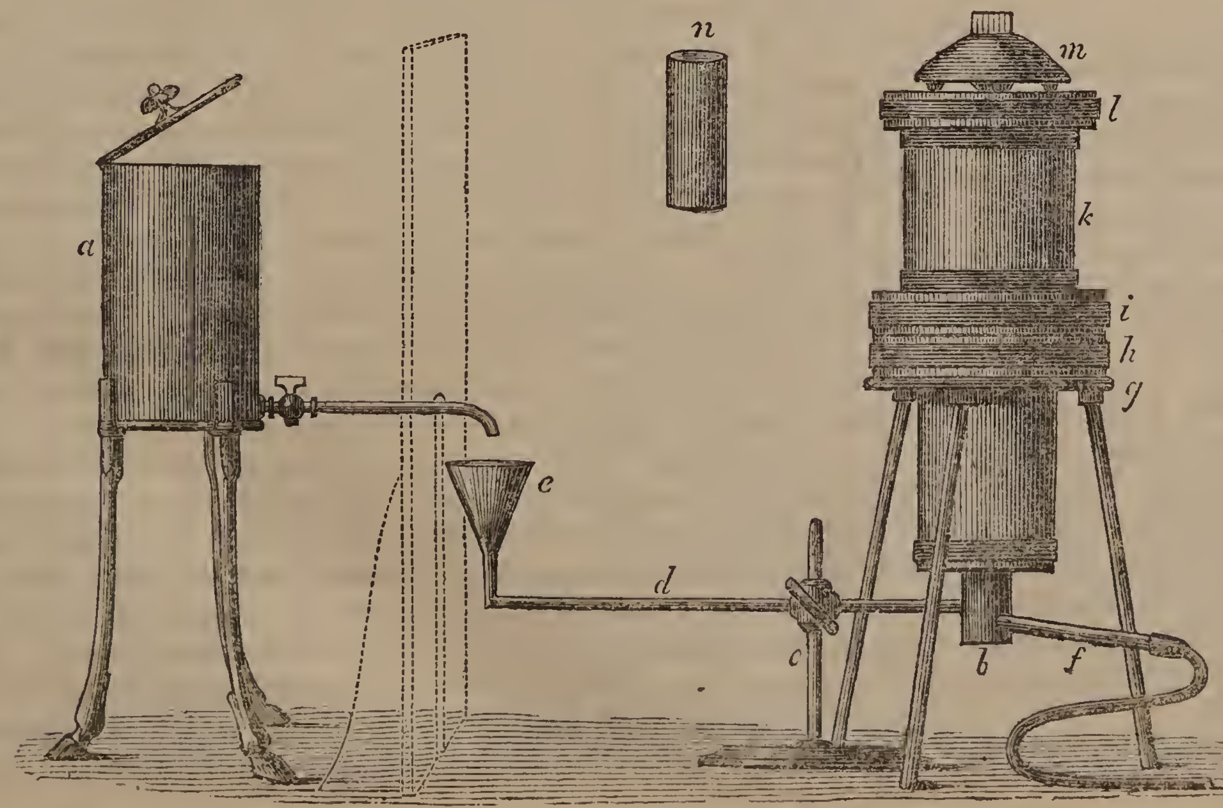
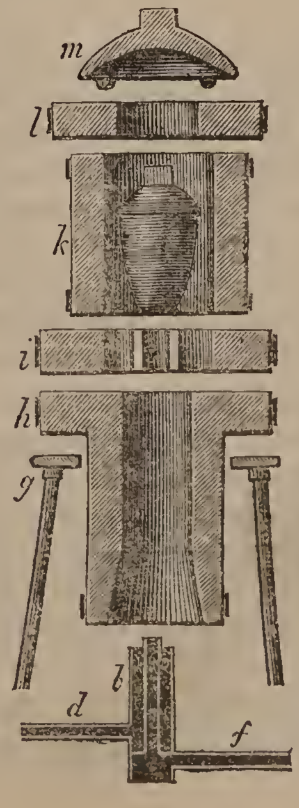


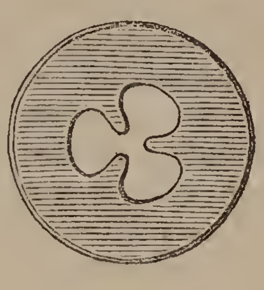
FIG. 2.



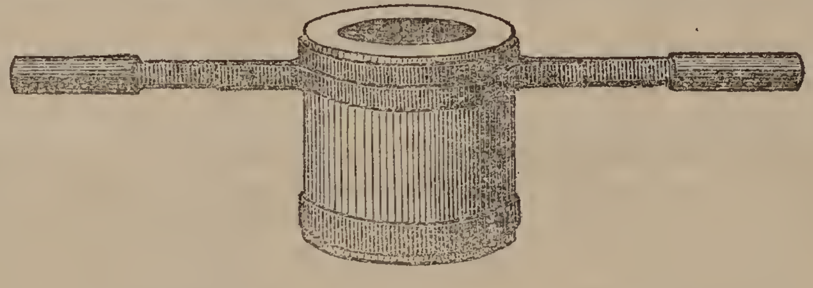
with a brass stopcock and delivery-tube. Its capacity is a little more than a quart. The wick-holder is represented at letter *b*, and the upper surface of it by the separate figure *c*. The wick-holder and the oil-reservoir are consequently detached.—*d* is a tube which brings oil from the funnel *e*, and *f* is a tube to be placed in connexion with the blowing apparatus. The wick-holder contains three concentric wicks, placed round the multiple blowpipe *c*, which is in communication with the blowing tube *f*.

The crucible furnace consists of the following parts:—*g* is an iron tripod; *h* is a flue for collecting and directing the flame. This flue is of such a width, that when the wick-holder *b* is pushed up into it until the top of the wick is level with the top of the clay cone, there remains a clear air-space of about $\frac{1}{8}$th inch all round between the wick-holder and the cylindrical walls of the flue.—*i* represents a fire-clay grate, having three tongues, shown by *i*, the separate figure of its upper surface. These tongues support the crucible, without stopping the rising flame.—*k* is a fire-clay cylinder, which rests upon the grate *i*, and encloses the crucible, forming, in fact, the body of the furnace. Of this piece there are three sizes: the smallest is of 3 inches bore, and works with crucibles that do not exceed $2\frac{3}{4}$ inches diameter; a middle size, 4 inches bore, for crucibles not exceeding $3\frac{1}{2}$ inches diameter; the largest size, 5 inches bore, for crucibles not exceeding $4\frac{3}{4}$ inches diameter. This piece being heavy, is provided with handles, as represented in the following figure. The walls of these cylinders are from 1 to $1\frac{1}{2}$ inch thick.—*l* is a flat plate of fire-clay, with a hole in the centre, used to cover the cylinder *k*, so as to act like a reverberatory dome; *m* is a cover which prevents loss of heat from the crucible by radiation, but gives egress to the gaseous products of the combustion of the oil; *n* is an extinguisher to put over the wick-holder when an operation is ended; and *o* is a support for the wick-holder.

c



i



No chimney is required.

Management of the Oil-Lamp Furnace.—The apparatus is to be arranged for use as it is represented by Fig. 1. The cylinder *k* is to be selected to fit the crucibles, and that to suit the quantity of metal that is to be melted. 1 lb. of iron requires the smallest of the three cylinders described above; $1\frac{1}{2}$ lb., the middle size; 5 lbs., the largest size. The air way between the crucible and the inner walls of the cylinder should never exceed $\frac{1}{4}$ inch, nor be less than $\frac{1}{8}$ inch.

The cotton wicks must be clean, and be trimmed a little below the level of the blowpipe *c*. If properly managed, they do not readily burn away, but can be used for several fusions. The reservoir should be filled with oil for each operation. The proper sort of oil for use is the more volatile kind of mineral oil, of the specific gravity of ·750, which is now easily procurable at about 3s. per gallon. The variety known by the commercial name of turpenzine answers well. The combustion of a quart of this oil, costing 9d., gives heat sufficient to melt 5 lbs. of cast iron. Probably the lighter kinds of paraffin oil may be suitable, but I have not had an opportunity of trying them. Liquids of the alcohol class, spirits of wine, and pyroxylic spirit can be used, but they are less effective and more expensive than turpenzine. Care must be taken not to spill the oil on the table or floor, and not to decant it carelessly in the neighbourhood of a light, because atmospheric air strongly charged with the vapour of these light oils is explosive. When the oil is burnt in the furnace, in the manner described below, there is no danger. During an operation, a wooden screen, as represented by the dotted lines in figure 1, should be placed between the oil reservoir and the furnace, to prevent the vaporisation of the oil by radiant heat.

As the wick-holder *b* and supply-pipe *d* contain only about one fluid ounce of oil, the oil must be run continuously, during a fusion, from the reservoir *a* into the funnel *e*, in order that the cotton may be always flooded. The success of the fusion depends upon the due supply of oil, to which point the operator must pay attention. At the commencement of a fusion, the oil must be run from the reservoir until the surface of the oil in the funnel has a diameter of about an inch. The wicks will then be flooded, and a light may be applied, and a gentle blast of air set on. The oil immediately sinks in the funnel; and the stopcock must be opened, and so regulated as to keep the oil barely visible at the bottom of the funnel. If too much oil is supplied, it immediately rises in the funnel, and simultaneously overflows the wick-holder. Too much vapour is then thrown into the furnace, and the heat is immediately lowered, especially at the beginning of an operation, before the fire-clay portions of the furnace are well heated. If, on the contrary, too little oil is supplied, the wicks burn, and the operation is spoilt. The demand of the wick-holder for oil depends upon the condition of the furnace and the character of the fusion in progress. When the lamp is newly lighted and the furnace cold, the oil should be passed slowly, in distinct drops; but, as the furnace becomes hot, the rapidity of the supply of drops should be increased; and, finally, when the furnace is at a white heat, the oil should be supplied in a thin continuous stream. When the fusion to be effected is that of only a small quantity of metal, such as 1 lb. of iron, a rapid supply of drops of oil is sufficient even to the close of the operation. At that rate, the burner consumes about $1\frac{1}{4}$ pint of oil in an hour. When the fusion to be effected is that of 4 lbs. or 5 lbs. of iron, and the large furnace is in action and has been brought to a white heat, the supply of oil must be, as stated above, in a thin continuous stream, and the operation will then consume 2 pints of oil in the hour. And here it requires remark that, with that continuous supply, when the furnace is large and is at a white heat, the oil does not rise in the funnel, being instantaneously converted into gas at the mouth of the burner, and thrown up in that state into the furnace for combustion. The operation, indeed, consists, at that point, of a rapid distillation of oil-gas, which is immediately burnt, in the presence of air supplied at a suitable pressure by a dozen blowpipes, in effective contact with the crucible to be heated.

The flame produced in this furnace is as clear as that produced by an explosive mixture of air and coal-gas. It is perfectly free from smoke; and the unconsumed vapours which occasionally escape with the gaseous products of the combustion are even less unpleasant to smell and to breathe in than are those which are usually disengaged by a blast gas furnace, or by an ordinary lamp fed with pyroxylic spirit.

The contents of a crucible under ignition in this furnace can at any moment be readily examined, it being only necessary to remove the pieces *l* and *m* with tongs, and to lift the cover of the crucible, during which the action of the furnace is not to be interrupted.

When the operation is finished, the blast is stopped, the stopcock is turned off, the oil-reservoir is removed, the wick-holder is lowered on the support *o*, withdrawn from the furnace, and covered with the extinguisher *n*. The quantity of oil which then remains in the lamp is about one fluid ounce.

Power of the Oil-Lamp Furnace.—The furnace being cold when an operation is commenced, it will melt 1 lb. of cast iron in 25 minutes, 1½ lb. in 30 minutes, 4 lbs. in 45 minutes, and 5 lbs. in 60 minutes. These results have been obtained in my experiments. When the furnace is hot, such fusions can be effected in much less time; for example, 1 lb. of iron in 15 minutes. It need scarcely be added that small quantities of gold, silver, copper, brass, German silver, &c., can be melted with great ease, and that all the chemical processes that are commonly effected in platinum and porcelain crucibles can be promptly accomplished in the smallest cylinder of this furnace; and, in the case of platinum vessels, with this special advantage, that the oil-gas is free from those sulphurous compounds, the presence of which in coal-gas frequently causes damage to the crucibles.

Requisite Blowing Power.—The size of the blowing machine required to develop the fusing power of this oil-lamp furnace depends upon the amount of heat required, or the weight of metal that is to be fused. For ordinary chemical operations with platinum and porcelain crucibles, and even for the fusion of 1 lb. of cast iron in clay or plumbago crucibles, a blowing power equal to that of a glass-blower's table is sufficient, provided the blast it gives is uniform and constant. But the fusion of masses of iron weighing 4 or 5 lbs. demands a more powerful blower, such as is commonly used in chemical laboratories for the supply of air to blast furnaces when fed by gas or coke. The highest power of the oil-lamp furnace depends, indeed, upon the power of the blowing-machine that is to be used with it. Much more than 5 lbs. of iron can be melted by the gas which this oil-lamp is capable of supplying, provided a sufficiently powerful blowing-machine supplies the requisite quantity of air. When more than a quart of oil is to be rapidly distilled into gas, and the whole of that gas is to be instantly burnt with oxygen, it is evident that effective work demands a large and prompt supply of air.

Cost of the Oil-Lamp Furnace.—As in all practical matters of this sort the cost is a main question; it may be useful to state that the price of this apparatus, complete, without the blowing-machine, but including every other portion necessary for heating crucibles up to the size sufficient to fuse 1 lb. of cast iron, is one guinea; and that with the extra furnace-pieces for crucibles suitable for 5 lbs. of iron, or any intermediate quantity, the cost is a guinea and a half.

PHARMACY, TOXICOLOGY, &c.

On Spiritus Ammoniæ Aromaticus,
by W. T. Fewtrell, *F.C.S.*

Aromatic spirit of ammonia, commonly called sal volatile, is directed by the Pharmacopœia to be made with such proportions of carbonate of potash and chloride of ammonium as it is supposed will produce a neutral carbonate of ammonia in solution in a mixture of spirit of wine and water, with flavouring substances; but, as sometimes happens with the most meritorious designs, it would seem that the purpose intended is not always fulfilled. It should have been premised that it is with the spirit of the Pharmacopœia of 1851 we are dealing; and it now almost requires an apology for noticing this article. Whatever apology, however, may be necessary, has been recently supplied by a contemporary. The formula about to be introduced by the British Pharmacopœia will be noticed in due time: for the present we return to the Pharmacopœia of 1851.

In this work we find the following recipe:—Take of hydrochlorate of ammonia, six ounces; carbonate of potash, ten ounces; cinnamon and cloves, bruised, of each two drachms and a half; lemon peel, five ounces; rectified spirit and water, of each four pints; mix, and distil six pints. The result of this process is stated by Pereira and Royle to be the production of chloride of potassium, and neutral carbonate of ammonia, which latter distils over with spirit, water, and essential oils. How far this statement is really true, and what the distilled product contains, remain to be seen.

The Pharmacopœia continues—"*Hujus pondus specificum est*"—("formula," as a recent novelist writes)—"918."

We have here again an invariable specific gravity asserted, which in practice it is found almost impossible to secure.

We are, of course, well aware that sal volatile is often made by private formulæ; and that some which enjoy the highest repute are made by other than the Pharmacopœia process. We do not suppose that this fact has tended to swell the records of mortality greatly; but we must not be supposed to defend any deviations from the authorised formulæ.

In some instances, respectable druggists keep two preparations: one made according to the Pharmacopœia for dispensing; and another made for retail, more pungent, as suiting better the public taste.

We confine our notice to the preparation made exactly according to the Pharmacopœia, and the question to be determined is, in what state is the ammonia in that preparation? Is it really monocarbonate, or does there exist, in a genuine Pharmacopœia preparation, any free ammonia?

In order to determine this point, four times the proportions of the Pharmacopœia were distilled, so as to produce an article made on a manufacturing scale. The distillation was effected in an earthenware retort; and, as the use of a worm are liable to inconveniences, the product was condensed in two globular condensers set perpendicularly in separate vessels of water, and connected by means of an earthenware tube. The vessels were kept cool by a current of water passing in at the bottom and out at the top.

Spt. Am. Aromaticus.

Small samples of every half-gallon of the product were taken as it came over. For the information of those practically unacquainted with the process we give a brief description of these separate portions:—

No. 1. Sp. gr. ·862, was a clear bright liquid, which deposited crystals. The odour was pungent, but only faintly aromatic.

No. 2. Sp. gr. ·870, was a clear bright liquid, which deposited crystals. The odour was pungent, but only faintly aromatic.

No. 3. Sp. gr. ·874, was a clear bright liquid, which deposited crystals. The odour was pungent, but only faintly aromatic.

No. 4. Sp. gr. ·930, was also a clear liquid, but deposited no crystals. The odour was less pungent, but still only faintly aromatic.

No. 5. Sp. gr. ·988, was a slightly turbid liquid, with a faintly ammoniacal odour, but much more aromatic.

No. 6. Sp. gr. 1·0002, was more turbid, very slightly ammoniacal, but still more aromatic, the smell of cloves predominating.

No. 7. The whole mixed together and filtered, was a clear and, at first, colourless liquid, having the specific gravity ·938.

The first point in the chemical examination was to determine the composition of the crystals deposited in Nos. 1, 2, and 3. They were analysed by Mr. Crookes, and were found to consist of bicarbonate of ammonia. Crystals, similarly obtained, had previously been analysed by Mr. C. H. Wood, who arrived at the same result. The liquid portion of No. 3, in which these crystals were deposited, was next examined, with the following results:—

Total ammonia in 100 parts	2·312
Carbonic acid	1·101

Calculated for monocarbonate of ammonia, this result shows an excess of the alkali equal to 1·011 per cent. So far, then, we have bicarbonate of ammonia deposited (on account of its insolubility in alcohol), and a considerable amount of uncombined ammonia in the solution.

We may pass over the composition of the other solutions, and now only quote that of the finished product, in which, of course, the crystals deposited in Nos. 1, 2, and 3 were dissolved. In this liquid the proportions were as follows:—

Total ammonia in 100 parts	2·120
Carbonic acid	1·473

Calculated as before, for monocarbonate of ammonia, the results show the presence of free ammonia to the extent of 0·38 per cent. It follows, that aromatic spirit of ammonia, made in strict accordance with the directions of the Pharmacopœia, contains free ammonia.

This fact, perhaps, is not difficult to account for. The reason for it will probably be found in the known instability of the salts of ammonia in a state of vapour. It would seem that what Deville calls disassociation, and what Messrs. Wanklyn and Robinson regard as decomposition, takes place with carbonates of ammonia* at comparatively low temperatures; and that, before the constituents can again unite, a portion of the carbonic acid makes its escape.

Leaving, however, this part of the question to be settled by more competent authority, we may repeat, that this experiment shows that aromatic spirit of ammonia, made strictly according to the Pharmacopœia, may contain free ammonia, and that its specific gravity may be as high as ·938. The difference between this number and ·918 is indeed small; but we have seen that differences quite as small have been made use of to fix an undeserved stigma on the character of a conscientious manufacturer.

One other point deserves a primary notice. It is said that if only the exact quantity ordered by the Pharmacopœia is drawn off, the sal volatile will remain without colour. In the experiments recorded, the exact quantity was drawn off, and now, after little more than a month, the liquid, which at first was colourless, has become decidedly brownish.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture I.—*Thursday, December* 10, 1863.

I may, Ladies and Gentlemen, preface these lectures by a few remarks concerning the lectures themselves. They have been established by a Dr. George Swiney, who, some years ago, left a sum of money to be devoted to that purpose. That sum is invested in the trustees of the British Museum; and the lectureship, which can only be held for five years, must be held by a graduate of the Medical faculty of the University of Edinburgh. The trustees have been pleased to confer upon me the honour of Swiney lecturer for the ensuing five years.

We will now proceed, if you please, at once with our subject.

Geology has for its object the study of the nature and mode of formation of the exterior of the earth, which alone is accessible for investigation. That exterior is usually designated the "crust" of the earth, an expression which implies necessarily that the interior is not solid, but is in a state of greater or less liquidity. The received hypothesis is, that our planet was once molten, and that in the lapse of ages it has gradually cooled down, and has become solid on its surface. On the present occasion, I do not propose to examine the foundations of this hypothesis. I use the word "crust" simply because it is a term perfectly well understood, and generally accepted, and not because it is any exponent of my belief on this subject.

We are acquainted altogether with about sixty elementary bodies—simple substances, as chemists term them—which cannot be divided into any simpler forms of matter; and it is really remarkable how few constitute the great bulk of the earth's crust—not more than five. These five are silicon, aluminium—the basis of alumina, calcium—the basis of lime, and oxygen, and carbon. The states of combination in which they occur are silica, that is, silicon combined with oxygen; alumina, that is, aluminium combined with oxygen; and lime, or calcium combined with oxygen; and this lime is, for the most part, or, at all events, to a very large extent, in combination with carbonic acid, constituting marble and limestone in its various forms. Perhaps next in abundance we may rank magnesium; but on this point I cannot speak with anything like certainty, and I should be very unwilling to commit myself to a definite numerical statement on the subject. We are now speaking, bear in mind, of the solid crust of the earth. Then, perhaps, would come hydrogen, iron, sodium, potassium, manganese, chlorine, sulphur, and phosphorus. The hydrogen to which I allude is that existing in combination with oxygen in the form of water, and present in a state of solid combination in all clay. It is not there, as chemists term it, as hygroscopic water, water simply of moisture, which can be expelled at a low temperature, but it is there in a state of actual solid combination, and we may, there-

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* A recent experimenter, whose name and the reference to whose paper at the moment escapes us, asserts that when a solution of chloride of ammonium is boiled for some time, the liquid becomes acid from loss of ammonia.

fore, consider it to be one of the constituents of the solid crust of the earth.

The geologist everywhere meets with problems of the highest interest which chemistry alone can solve; yet it is somewhat surprising that in this country of geologists the application of chemistry to the solution of geological phenomena should hitherto have received so small a share of attention. Geology, it must be admitted, is a most comprehensive science, and, to be studied as a whole, requires knowledge so varied and so extensive that there is, perhaps, no living geologist who can be said to have mastered the subject in all its details. It demands more than a superficial acquaintance with physics, mechanics, inorganic chemistry, mineralogy, comparative anatomy, and botany. Where is the man who possesses this combination of acquirements? Not a few persons have attained the reputation of geologists who have either been ignorant of the great foundations of the philosophy of geology, or have had a very slight knowledge of the subject. To know and to remember the order of superposition of rocks, and to be able to recognise the fossils which they respectively contain, does not, I apprehend, entitle a man to rank as a philosophical geologist. As well might a taxidermist lay claim to the title of zoologist, or an ornithologist to the title of botanist. The conquests which remain to be achieved in geology will, doubtless, result from the special study and application of the various sciences which essentially compose the great science of geology, and there is assuredly no line of investigation which promises richer fruit than that relating to chemistry.

Having made these preliminary remarks, we will, if you please, proceed at once to examine the subject of this morning's lecture. That subject is silicon, perhaps the most abundant, or, certainly, one of the most abundant elements in the solid crust of the earth. This silicon has only recently been investigated in anything like a satisfactory manner. It exists in, and is the foundation of silica in its various forms. Silica exists in the well-known form of quartz, and consists of silicon combined with oxygen. In sand and in all clay, and in igneous rocks of various kinds, it is an essential constituent. In fact, it is everywhere. This silicon, when once united with oxygen, requires an extraordinary amount of affinity, or the exercise of an extraordinary force to *detach* it therefrom.

Silicon exists in three distinct states, the amorphous or formless state, in the graphitic state, and in the state of crystallised octahedral silicon. I have here placed before you some very fine specimens of silicon, for the loan of which I am indebted to Mr. Matthey, of Hatton Garden. They are as fine as can well be seen. I shall not attempt to describe the substances which are prepared from silicon, as that would occupy too much of our time.

In its three states, silicon differs considerably. In the amorphous state it occurs in the form of a chocolate brown powder. In the graphitoidal state it is exactly like graphite, or very similar, occurring frequently in small hexagonal plates, as produced in the process for making aluminium. Then we have the octahedral form, the same form and the same crystalline system as that to which the diamond belongs. But here it is a most beautiful substance, of a metallic lustre, and a dark bluish grey colour, considerably more blue then ordinary graphite, and, I think, more metallic in lustre.

Silica consists, in round numbers, of about 48 parts of this silicon, and 52 of oxygen. The atomic formula adopted, and first suggested by Berzelius, is this, $Si\,O_3$, representing one equivalent of silicon combined with three of oxygen; but there are reasons for supposing that the more accurate expression is $Si\,O_2$, one equivalent of silicon combined with two of oxygen.

Now, long ago it was ascertained by Schafgotsch that silica exists in two very different states. In one state it was crystallised as quartz, having a specific gravity of 2·6. All quartz, for example, has this specific gravity, and not only quartz, but chalcedony, hornstone, and flint, and yet these present no outward sign of crystalline structure. It is, however, maintained by Rose, and with some plausibility, that they consist of an aggregation of excessively minute crystals. He designates these forms of quartz as *crystalline*, in contradistinction to the ordinary form of rock crystal, which is distinctly *crystallised*. We have, then, crystalline quartz, and this apparently non-crystallised form of quartz which I have just mentioned, chalcedony and the like, of the high specific gravity 2·6.

Now, there is another form of silica in which the specific gravity never exceeds 2·3. It ranges from 2·2 to 2·3, and is never higher than that. This is what is termed amorphous, apparently non-crystalline silica; and these facts, you will perceive directly, have or may have a very important bearing on certain geological considerations of the highest importance. All the crystallised silica of the high specific gravity polarises light. The amorphous silica of low specific gravity does not polarise light. The distinctly crystallised silica which we have here in the form of quartz, when pulverised, reduced to extremely fine powder by trituration and levigation, does not differ chemically in any sensible respect from the powder of the apparently amorphous form of silica, flint, chalcedony, and the like. Both resist the action of boiling alkaline solutions, whereas the amorphous silica is copiously and readily dissolved by such solutions. The crystallised silica is produced in the wet way, and, so far as we know, only in the wet way. By the wet way, I mean through the agency of liquids, never by fusion at a high temperature. The late M. Senarmont, who has devoted considerable attention to the artificial formation of minerals, made microscopic crystals of quartz by dissolving silica in the nascent state, that is, at the moment of its separation from a state of combination, in very dilute hydrochloric acid, and then exposing that solution in a closed tube to a temperature of between 200 and 300 centigrade. These crystals he found to be precisely similar in crystalline form and all other essential respects to those actually occurring in nature, being in the form of six-sided prisms, terminated by the usual pyramids found in crystallised quartz, and having hexagonal faces presenting the transverse striæ which we so constantly see on these crystals. Here, then, is a clear experiment proving the production of crystallised silica by the agency of liquids, exactly similar, in all essential respects, to the rock crystal of nature. It is true that the crystals were very small; but that in no way affects the truth of the conclusion to which I shall draw special attention by-and-by; but all this crystallised silica, of which you have such a fine specimen before you, has been produced in nature by the agency of liquids, and not by fusion at a high temperature, Sorby obtained crystalline silica. I use the word *crystalline*, because it was not distinctly *crystallised*. His specimens he examined carefully by the microscope, and he was able distinctly to recognise the forms. He first obtained this form by passing chloride of silicon into a tube along with the vapour of water, but he afterwards procured still more distinct crystals by decomposing glass at a high temperature by the agency of water. We may take an ordinary piece of glass and boil water in it for almost any length of time, without appreciably acting upon it; but if we expose ordinary glass to the action of water at a high temperature in a close vessel the result is different, and the glass is rapidly attacked and corroded. By acting upon glass consisting of silica, lime, and potash by water, at a high temperature, he obtained the well-known mineral called Wollastonite, which is a silicate of lime; and he obtained perfectly transparent crystals of quartz, not less than two millimetres in length. Here, then, is a distinct experimental proof of the formation of characteristic crystals of quartz, similar to those occurring in nature, by the agency of water, simply at a high temperature, upon silicate of lime and potash, or soda, as the case may be. That is immaterial. It is a fact that the heavy compact and the crystallised silica often occur together, and hence we may infer the similarity of the conditions of their formation.

I am sadly afraid that I may lead to some confusion about this crystalline and amorphous silica, and, therefore, to be quite clear, allow me to say one or two words further upon the subject. We have quartz which is distinctly, manifestly crystallised. The specific gravity of that quartz is, as I said a short time ago, very high as compared with the other—2·6. Then we have another form of silica having the same specific gravity, yet not appearing crystalline to the eye, although there are certain reasons for supposing that it may be composed of an aggregation of excessively minute crystals. Then there is the other distinctly amorphous non-crystalline variety, which has the low specific gravity of 2·3. You see there are two apparently amorphous varieties of silica. There is the chalcedony, for example, and there is the mineral called opal. If we compare that piece of common quartz with opal, they both appear non-crystalline, and they both, therefore, might be confounded under the term "amorphous;" but the term "amorphous" is restricted to this particular form of solid silica having the low specific gravity.

All attempts to crystallise silica by fusion have hitherto failed. Many experiments were made upon this subject a long time ago by means of the oxy-hydrogen blow-pipe. Silica has been distinctly fused into small globules. There is no great difficulty about that. More recently, Deville, who has paid special attention to the application of high temperatures to metallurgical purposes, has succeeded in fusing silica in considerable quantities, and he has subjected it to slow cooling, but never in a single instance has there been the slightest trace of crystallisation; and such silica—silica fused at these high temperatures—has always the low specific gravity of 2·3. You will see the bearing of that by-and-by upon the supposed formation of granite and certain other igneous rocks. If we take a piece of this crystallised quartz of a high specific gravity, and fuse it, we convert it into a substance somewhat resembling the silica of the low specific gravity, having the gravity of 2·3. Now that is apparently a small fact, but in a geological point of view it is one of the highest interest. Formerly, it was a marvel to melt a bit of platinum as big as a pin's head. Now, Deville has succeeded in melting it in a mass as big as that of which this is a model. The real piece was in the Exhibition of last year. This platinum sometimes contains silicon, and in fusion the silicon becomes oxidised, and converted into silica, and you get the melted silica swimming on the top of the melted platinum in the form of a thin, transparent, colourless liquid, so high is the temperature.

I have now to speak especially of certain important experiments, made by Gustave Rose, upon the subject of the specific gravity of silica as determined by temperature. It is a curious point that he found, that when perfectly transparent, entire rock crystal underwent long exposure, say for eighteen hours, to a porcelain furnace, in which the temperature is exceedingly high, though nothing so high as that required for the fusion of platinum—being estimated at about 2000° centigrade—there was no alteration in the specific gravity at this temperature; but when the same crystal was exposed to the same conditions of temperature, having been previously pulverised—reduced to fine powder—its specific gravity was reduced from 2·6 to 2·3. Again, he found in the case of common flint having a specific gravity of 2·591, owing to certain impurities which interposed, that by exposure to this high temperature for a long time, its specific gravity was reduced to 2·237. There, again, is another example of the influence of high temperature in reducing the specific gravity of silica in this particular state of aggregation.

We have now to consider more particularly this amorphous silica, or that form of silica to which Professor Graham has so well given the name of "colloidal, or jelly-like silica." This silica is obtained in various ways, which are very well known in the laboratories of chemists. It is obtained by the decomposition of silicates by acids. If I take a silicate of potash or a silicate of soda, which will dissolve readily enough in water, the solution of which is known by the name of water-glass, about which we have heard so much with regard to the preservation of stone and the like, and add, under certain conditions of dilution and so forth, an acid to that water-glass, the silica will immediately separate in the form of a jelly—such a jelly as I have here; it might be mistaken for a piece of ordinary jelly. Under other conditions of dilution there would be no immediate separation of jelly whatever, but the whole of the silica will be retained in solution, though it be separated from its combination with the base by the addition of a stronger acid; but, on keeping, it will ultimately gelatinise, or during evaporation, by the application of heat, the silica will be thrown down in the same jelly-like state. We will make this experiment before you, that you may see the result for yourselves. These experiments may seem very small; but, at the same time, they are extremely interesting in reference to certain geological phenomena. Here it is immediately a great lump of jelly. There is no mistake about the fact. It may be inverted without being spilled. Well, now we will try the other condition, and see if we can retain it all in solution. Sometimes things do not go quite as they ought. It depends entirely upon the degree of dilution. There it is; but still there is a large amount of water contained in the silica; and, if time permitted, we could soon render that evident by the application of heat and evaporation; but it would take more time than we can devote for the purpose. When evaporated to dryness this jelly forms a white, amorphous powder, exactly like that which I hold in my hand. This gelatinised silica, or colloidal state of silica, is produced by the action of water on a peculiar compound termed "fluoride of silicon"—a well-known compound in the laboratory of chemists. It is a gaseous compound, consisting of silicon in combination with the element fluorine, which is an essential constituent of common fluor spar. It is a perfectly transparent, colourless gas, which immediately suffers decomposition by contact with water: hence, when this gas is allowed to escape into the atmosphere, under ordinary circumstances it produces a copious white smoke, due to the formation and deposition of silica. We will endeavour to prepare it here. We have in the flask a quantity of fluor spar and sand. We mix that with sulphuric acid, and, under these conditions, the fluoride of silicon is formed, which, in passing through water, becomes immediately decomposed, depositing gelatinised silica. If we were to plunge the delivery-tube, conveying the gas, into water, the quantity of silica immediately produced would be so great as to stop up the tube, and to burst the flask. In order to avoid that effect, it is usual to place at the bottom of the vessel a quantity of mercury, over which is the water, and to let the gas escape in the mercury, and below the water. This gelatinous silica, when dry, forms an exceedingly light powder. In fact, it is in a state of the extremest possible division. As far as I know, there is no other way of making amorphous silica in such a fine state of division as this.

We will now notice the solubility of silica. And this is a subject of very high importance to geologists.

Now, in an aqueous solution of potash, for two parts by weight of solid potash in solution there is dissolved one part by weight of this extremely fine silica in fluoride of silicon. Of silicon in the state of quartz there is dissolved ·009 for two parts by weight, and of silica in the state of flint there is dissolved ·038. This difference is due simply, or, at all events, in a great measure, to a difference of aggregation. When rock crystal has been actually melted, and then pulverised, it is as soluble in this menstruum—this solvent—as the silica from the fluoride of silicon, obtained by the decomposition of water. Silica dissolves, to a certain extent, in water containing alkaline carbonates. The light variety is far more soluble than the heavy variety. An aqueous solution of carbonate of potash, or soda, for example, dissolves fifteen times more amorphous than crystalline silica. With regard to the solubility of silica in pure water, Bischoff states, that one part of silica dissolves in 769230 parts of water.

I have now to bring before your notice some results obtained by Professor Graham, which are as interesting as they are novel, and, I think, important. I allude to the phenomena of dialysis, which will possibly hereafter be found to explain many obscure geological phenomena.

Now let us see what we mean by the term "dialysis." Here is a common vessel of glass, and here is some paper termed "parchment paper," prepared in a particular way. Here is a hoop of gutta percha. The paper is tied round this hoop, or fixed in this hoop, so that you get a circular vessel, the bottom of which consists of this parchment paper. Now, into this glass vessel we may suppose we place pure water, and into the hoop vessel we will place some of that solution that we had just now—a solution of silicate of soda to which the acid has been added in such a way as not to precipitate the silica. Here is that solution. Into the hoop we will put the solution, and then place the whole on some pure water, and there leave it. What will take place? Well, in the course of time a certain proportion of the silica will pass through that membrane into the other constituents in the solution, but eventually there will remain in the floating hoop vessel, covered with paper at the bottom, a pure solution of silica. All the hydrochloric acid will be gone by virtue of the operation of that paper. The chloride of sodium, or potassium, as the case may be, will be gone—with a certain proportion of silica, it is true—and there will remain at length a pure, limpid, colourless solution of silica.

Professor Graham has been so kind as to supply me with illustrations for this lecture, which I will now place before you. I really do not know any discovery which is of higher interest, or promises more important results, or more beautiful results, than dialysis. Here is a 5 per cent. solution of silica. The water contains 5 per cent. of silica. There is no base there to retain that silica in solution. There it is—a pure limpid solution of silica in pure water. In the course of time, if the solution has a certain strength, it will gelatinise, or, as Professor Graham calls it, pectise—form jelly. The weaker and purer the solution, the less tendency it has to gelatinise. Professor Graham expresses an opinion, that with one per cent. of silica dissolved in it, the solution might be preserved for an indefinite length of time without change.

There are some very curious properties about this solution to which I am very anxious to call the attention of geologists especially. This solution may contain as much as 14 per cent. of silica, and yet be perfectly limpid, and not in the least viscous. It may be boiled in a flask for a considerable time, and concentrated considerably without change. When heated in an open vessel a ring of insoluble silica is apt to form around the margin of the liquid, and this may soon cause the whole to gelatinise. The solution is, as I said, durable in proportion to its purity. It is not easily preserved beyond a few days unless considerably diluted. It becomes opalescent after a short time, and then the jelly separates; and once separated, it cannot be redissolved in water. When the jelly is formed suddenly it is always more or less opalescent. Here is some which has been formed slowly by Professor Graham. It is a perfect jelly, perfectly colourless and limpid, like rock crystal. If you just touch it slightly in that way you give rise to a vibratory tremor. It contracts, after a few days, even in a close vessel, and then pure water separates from it. It is a very curious fact in connection with it, that coagulation, or the separation of silica in the jelly-like state, is effected in the course of a few minutes by a solution containing one ten-thousandth part of any alkaline or earthy carbonate, but not by caustic ammonia or neutral or acid salts, nor by sulphuric, nitric, or acetic acid. Coagulation occurs in a short time after passing carbonic acid through the solution. We will make the experiment of producing the jelly by the addition of a little carbonate of soda to this solution. It is one of the prettiest experiments connected with the subject. I am sorry I cannot present it on a larger scale. This is a perfectly limpid liquid solution. Now, after adding a little of this solution of carbonate of soda to it, we shall soon have it, I think, so solid that we shall be able to invert the glass without spilling it. It always takes a little time; and when it is suddenly made, it is always, as I have said, opalescent, and not transparent like that which you have in the tube. Hydrochloric acid, on a small quantity of caustic potash or soda, gives stability to the solution. It has a slightly acid reaction, somewhat greater than that which may be produced by carbonic acid. Dried by the air-pump *in vacuo*, at the ordinary temperature, it forms a beautiful, transparent, glassy mass of great lustre, no longer soluble in water, and which reminds one greatly of that beautiful variety of opal termed "hyalite." Here it is. It is, in fact, opal. This is some prepared by Professor Graham in the way mentioned. The jelly has been dried by evaporation *in vacuo*. It may retain as much as 21 or 22 per cent. of water.

I am just selecting all those points which I think have an express bearing on geology. Ordinary silicate of soda is not at all what is termed "colloidal;" that is to say, if I were to put this silicate of soda into this hoop-vessel, and leave it there floating upon the water, it would pass through, to a certain extent, to the water, but there would be no separation of its constituents. When hydrochloric acid is added and the constituents eliminated, then it is that you get this action set up. This soluble form of silica unites with various organic matters, as, for example, with common gelatine, or with skin. In fact, you may tan by means of silica, and produce leather containing as much as 70 per cent. of silica.

We will now inquire, with regard to this peculiar solution of silica obtained by Professor Graham, whether there is any reason to suppose that a similar process to that by which this is prepared may play any part in the operations of nature. The condition required is, that there should be a soluble silicate, and there is no difficulty in explaining how this may be produced. This we shall examine hereafter, when we speak of the silicates. The condition is, a soluble silicate dissolved in water, and the decomposition of that silicate by some agent, such as hydrochloric acid. We thus get the solution, and now for the apparatus. Does nature present us with any apparatus which can take the place of this so-called dialyser? All that we want is the porous bed of some rock like sandstone, in some convenient position, and that sandstone will act exactly as the dialysing apparatus here acts. It remains now for practical geologists to look out for these conditions, and see how far an application can be made of these important discoveries of Professor Graham.

I now call your attention to the separation of the silica. Every bubble of the fluoride of silicon as it passes up through the water becomes immediately decomposed, and a portion of the gas escapes, not being thoroughly in contact with the water everywhere, and produces a slight smoke. We want to avoid the production of that smoke as far as possible. I think we may really have reason to believe that this solution may play an important part in the phenomena of nature; for I think, as we shall see hereafter, that there is no difficulty in explaining how such a solution may be obtained as is requisite to exhibit the phenomena of dialysis; and I think that, very probably in nature, we may find conditions exactly suitable for dialysis. Well, then, if this be the case, we shall be at no loss to understand how in many instances silicification has occurred. We know that it has occurred, and occurred to an enormous extent, in nature. The mineral termed "opal," which I have referred to several times, is nothing more than amorphous silica containing a little water. The proportion of water is not definite; it is variable, the extremes being somewhere about 3 per cent. and 13 per cent. of water. Sometimes this opal exhibits most beautiful colours, and then it acquires the name of "precious opal." These colours are due to a peculiar structural arrangement, and may be explained by the laws of optics. Now, here is a mass of opal from Mexico; and if any one will just examine these two in contact—the substance prepared by evaporation *in vacuo* by Professor Graham's experiment, and the natural opal—he cannot fail to be struck with the resemblance between the two. The mineral termed "hyalite" is also a kind of opal met with in basaltic rocks. It is another form of amorphous silica. This hyalite contains an amount of water, the extremes of which are 3 and 6 per cent. Here is another specimen of it.

I will now call your attention for a minute or two to a peculiar substance which has been found in our blast furnaces or iron-smelting furnaces; and I think we shall see reason in the course of these lectures to believe, that even these processes which are so abundantly practised, or rather, practised on so large a scale in various parts of this country, may really furnish indications of great importance to the geologist. In the hearths of blast furnaces is occasionally found a white, delicate, fibrous substance, to which the name of "fibrous silica" has been given. It has been carefully examined, especially by Rose, who finds it to consist essentially of silica. It is silica in the amorphous state—silica produced at a high temperature, and, therefore, having a specific gravity not exceeding 2·2 or 2·3. It has been found in many furnaces. We are not perfectly certain yet as to the precise conditions under which it has been generated, but most likely it may have resulted from the oxidation of silicon. Sorby informs us that he obtained fibrous silica, exactly similar to that occurring in the hearths of blast furnaces, by passing that gas which we are now passing though the water, fluoride of silicon, together with the vapour of water, through a porcelain tube heated to red-whiteness. By introducing the fluoride of silicon at one end of the tube, and the steam at the other, he obtained silica only in small vitreous grains. That is the amorphous silica.

Now, I cannot forbear, before concluding this lecture, just for a second forestalling what I shall say hereafter in speaking of the formation of certain igneous rocks, especially of granite. I will make one or two remarks by way of inference from the facts I have now laid before you. For a long time it has been the received notion, that all granite, which occurs so abundantly in the crust of the earth, has been the result of igneous fusion at a very high temperature; but there are certain difficulties which have always been in the way of accepting this view of the subject—difficulties known, at all events, to those who have been accustomed to make experiments on the fusion of mineral substances at high temperatures. Now, let us look at the fact of quartz occurring in this granite. Granite consists, as most of us know, of three minerals—quartz, mica, and felspar. Quartz is crystallised, and always has the specific gravity 2·6. There is not a single instance known to the contrary. There is, therefore, reason to believe that that quartz never could have been fused; for we have seen that the moment we fuse silica, no matter in what state it was previously, you obtain a glass-like colloidal or non-crystalline mass, having a specific gravity never exceeding 2·3. If this be so, then I think you will agree with me that there is something like a foundation for the inference, even from this single fact, that such granite could never have been produced under the condition of a high temperature. What those conditions under which it was produced may be we shall hereafter consider.

PARIS ACADEMY OF SCIENCES.

December 21, 1863.

The only paper of interest read on this occasion was by M. Scheurer Kestner, "*On the Theory of Leblanc's Soda Process*," which, containing a reply to the views of Messrs. Gossage and Kynaston put forth in our pages, we shall translate at length in an early number.

NOTICES OF BOOKS.

The Pharmacopœia of the United States of America. Fourth Decennial Revision. By Authority of the National Convention for revising the Pharmaeopœia held at Washington A.D. 1860. Philadelphia: Lippincott and Co., 1863.

On the eve of the publication of the British Pharmacopœia, it may be of some interest to notice what has been doing in the same way in other parts of the world.

The Pharmacopœia of the United States, like the British, has been compiled by a national committee. Delegates of the various medical associations, colleges, and universities met at Washington in May, 1860; and it is worthy of notice that we find among them seven representatives of three colleges of Pharmacy. The preface to the work is dated June, 1863; so we conclude that the convention finished its labour in three years.

The preceding Pharmacopœia has undergone extensive alterations, and the present work appears to us, after a rather hasty perusal, to be eminently practical. The use of all weights but the ounce and the grain has been discarded; "and, to guard against the error of substituting the avoirdupois ounce, the word is now always printed *troyounce*." Our American brethren are, therefore, still left embarrassed with two ounces, and two pounds—an embarrassment which will, probably, disappear at the next decennial revision, if our own experiment should be found to answer well. The old wine gallon, and the pint of sixteen ounces, are still retained, but the gallon is never used in the Pharmacopœia.

Percolation is commonly employed for the exhaustion of materials, and careful directions are given for conducting the process. In connection with this, we find that the degree of comminution to which it is necessary to reduce different materials, is expressed by the words, *very fine powder*, *fine*, *moderately fine*, *moderately coarse* and *coarse*. The powder passed through a sieve of eighty or more meshes to the inch, is designated *very fine;* through one of sixty meshes, *fine;* through one of fifty meshes, *moderately fine*; through one of forty meshes, *moderately coarse;* and through one of twenty meshes, *coarse.*

The Materia Medica is arranged on just the same plan as is followed in our own Pharmacopœia. It includes most of the substances known here as the "New American Remedies," some of which we believe will be found in the British compilation; and other things, which, though in great repute, are seldom prescribed, at all events, in Latin, as for example, the following:—

"Spiritus Frumenti.—*Whisky.*—Spirit obtained from fermented grain by distillation; and containing from 48 to 56 per cent. of absolute alcohol. Whisky for medicinal use, should be free from disagreeable odour, and not less than two years old;"—in fact just the article proper for convivial purposes.

In the list of preparations there is much that we should like to extract, for in most cases the processes are practical, and the results we should think would be excellent. The list is arranged alphabetically, and one of the first things we come upon is *Aconitia.* The directions given for the preparation of this alkaloid are similar to those which we believe will be given in the British Pharmacopœia. But by the American process the aconitia is obtained in the anhydrous state as a hard, brittle, resinous substance, which has to be scraped from the dish, and reduced to powder. Now, in the case of so active a substance as aconitine, this must be a dangerous operation—one we would rather decline to perform—and it would be much better to render it unnecessary by precipitating the alkaloid in a hydrated form from an acid solution.

The aromatic *aquæ* we find directed in most cases to be made with the essential oils, by means of magnesia, in the way well known to all English pharmaceutists.

A very useful class of preparations has been introduced under the name of *fluid extracts*. These are in many instances really concentrated tinctures; but in some cases, where the greater part of the spirit is lost by evaporation, sugar is added to preserve them, as, for example, in Extractum rhei fluidum, the directions for preparing which are as follows:—

"Take of rhubarb, in moderately fine powder, sixteen troyounces; sugar, in coarse powder, eight troyounces; alcohol, a pint; diluted alcohol, a sufficient quantity. Moisten the rhubard with four fluidounces of the alcohol, introduce it into a conical percolator, stir it gently, and pour upon it the remainder of the alcohol. When the liquid has disappeared from the surface, gradually pour on diluted alcohol, until a pint of tincture has passed. Set this aside in a warm place until reduced by spontaneous evaporation to six fluidounces; and continue the percolation until two pints more of tincture have been obtained. Evaporate this by a gentle heat to six fluid ounces; then add the sugar, and, when this is dissolved, the reserved tincture, and continue the heat until the whole s reduced to the measure of a pint."

In some instances a small quantity of acetic acid is employed in these preparations, with advantage probably in the cases of ipecacuanha, ergot, and colchicum, but we do not see the object in the case of hemlock.

The chemistry of the Pharmacopœia, as illustrated in the preparations of iron and mercury, is, so far as we have seen, unexceptionable; but we remark that our American brethren in their nomenclature pass over differences of composition, and found their names on physiological and physical differences. Thus we have Hydrargyri chloridum corrosivum, and Hydrargyri chloridum mite, for the two chlorides of mercury; and Hydrargyri iodidum rubrum, and Hydrargyri iodidum viride, for the two iodides.

Among the Infusa we find nothing worthy of note, excepting that a small quantity of sulphuric acid is employed in cold infusions of bark prepared by percolation.

The Misturæ are mostly identical with those in our own Pharmacopœia; and many of the Pilulæ are well-known to us; but there is a form for Pilulæ ferri iodidi which we may quote, as some medical men have a fancy for prescribing iodide of iron in pills. It is as follows:—

"Take of iodine half a troyounce; iron, in the form of wire, and cut into pieces, one hundred and twenty grains; sugar, in fine powder, a troy ounce; marshmallow, in fine powder, half a troyounce; gum arabic, in fine powder, reduced iron, each sixty grains; water, ten fluid drachms.

"Mix the iodine with a fluidounce of the water in a thin glass bottle, add the iron, and shake them together until a clear, green solution is obtained. Mix the powders in a small porcelain capsule, and filter upon them, through a small filter, first the solution previously heated, and afterwards the remainder of the water to wash the filter. Then, by means of a water bath, with constant stirring, evaporate the whole to a pilular consistence, and divide the mass into 300 pills.

"Dissolve sixty-grains of balsam of tolu in a fluid drachm of ether, shake the pills with the solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring them until the drying is completed. Lastly, keep the pills in a well-stoppered bottle."

If successfully prepared, we have no doubt these pills will be "unchangeable."

(To be continued.)

NOTICES OF PATENTS.

2277. *Improvements in Extracting the Sulphur and Sulphurous Acid from the Oxy-Sulphuret of Calcium which is contained in the Residues or Waste Material obtained in the Manufacture of Soda.* W. Schnell, Charlotte Street, Fitzroy Square, London. Dated August 13, 1862. (Not proceeded with.)

In carrying out this invention, the waste material is in the first instance freely exposed to the action of the air. For this purpose it is spread out in thin layers upon frames or hurdles placed one above another, at such intervals as will allow of unrestrained access of air, the material being kept constantly moist for a period varying between two and three weeks, but never longer than a month. At the end of this time it is removed and lixiviated with water at a temperature not exceeding forty degrees centigrade, whereby a solution of hyposulphite of lime is obtained, and that portion remaining insoluble is again collected and exposed to air as before, until no further quantity of the hyposulphite can be extracted. For the recovery of the sulphur and sulphurous acid from these solutions, they are to be decomposed by hydrochloric acid at a boiling temperature, when the sulphurous acid gas is given off, and the remaining sulphur deposited in an elementary form; this last product is, after washing, perfectly pure. If it be desired to obtain the sulphur only, the hyposulphite solutions are evaporated to dryness, and distilled in iron retorts, but by this process only half the total amount is obtained, since the residue in the retort contains much sulphite and sulphuret of calcium. If, on the other hand, it be desirable to economise the whole of the sulphur in the form of the gaseous product (sulphurous acid), this process of distillation should give place to one of roasting, whereby in a current of air the main portion of the sulphur is driven off in an oxidised form, whilst the lime, in admixture with a certain quantity of the sulphate of that base, remains behind in the furnace.

The advantage of this mode of proceeding stands in unfavourable comparison with that by which the hyposulphite liquors are made to furnish the crystallised soda salt as the marketable product.

2295. *Manufacture of Colouring Matters.* John S. Blockey, Leeds. Dated August 14, 1862. (Not proceeded with.)

The inventor prepares red, blue, and purple colouring matters by acting upon aniline, or its homologues, with a mixture of nitric and hydrochloric acids, employed at the temperature of about 180° F. The several coloured products are formed simultaneously; they may afterwards be separated by known processes. The production of one or other of these dyes may be, however, to some extent, controlled, either by modifying the proportions of the two acids employed, or by taking more or less aniline or other homologous base.

2294. *Decolorising Solutions of Sugar, &c.* William Bird Herapath, Bristol. Dated August 14, 1862. (Not proceeded with.)

The inventor adds to the saccharine juice or solution of sugar a small quantity of the hypochlorite of an alkali or alkaline earth, using by preference the common bleaching powder, or hypochlorite of lime, dissolved in a small proportion of water. The lime thus added is afterwards separated by precipitation with the phosphate of soda or potash, and the insoluble phosphate of lime removed by filtration.

It is probable that this last-named compound would, like alumina, directly serve in the removal of colouring matters and suspended impurities from the raw juice or sugar.

2296. *Treating Crystallisable Sugar, to render it more suitable for Fermentation and Conversion into Alcohol and Vinegar.* William Bird Herapath, Bristol. Dated August 14, 1862.

In the treatment of highly-coloured samples of cane or beet sugar, it is recommended to bleach with hypochlorite of lime before proceeding to operate upon it by the mode which forms the subject of this patent. The sugar is dissolved in hot water (about 180° F.), with which a small proportion of moderately pure hydrochloric acid has previously been mixed; or the acid may be added subsequently to the solution of the sugar in water. The temperature is now raised to boiling, and maintained at that heat for two or three hours, after which the free acid is neutralised by the addition either of carbonate of potash or soda, lime water, milk of lime, chalk, or other suitable material, taking the precaution not to use any of these in excess. At this stage the saccharine solution will be found to undergo the alcoholic fermentation with unusual facility; it merely requires to be cooled and diluted to the point at which brewers are in the habit of starting the fermentation of beer-wort, and may be turned into vinegar by following the usual processes.

The action of hydrochloric acid at a boiling temperature would induce the conversion of cane into grape-sugar, which is known to undergo fermentation more readily than the original or crystallisable sugar.

CORRESPONDENCE.

Gas Combustion Furnace.

To the Editor of the Chemical News.

Sir,—In your report of the proceedings of the Chemical Society, inserted in this day's Chemical News, you attribute the description of a gas burner for organic analysis to "Dr. Herapath, of Bristol." As it came from me, I shall feel obliged by your correcting the mistake in your next number. I am, &c.

William Herapath, Sen.,
Professor of Chemistry.

Old-park, Bristol, Dec. 26, 1863.

The Patent Laws.

To the Editor of the Chemical News.

Sir,—In your last number you give a contribution to the fun of the season, and I am not sure but there is something similar on the same page, contributed by Mr. Williams. He compares capitalists, whose operations are hampered by the patent laws, to those who take other people's "pocket-handkerchiefs, watches, plate, purses, &c., burglars, pickpockets, and area sneaks." This may be good fun, but is it good sense? Is there any relation between the fancies of a schemer's brain and a man's purse? Seriously, this patent law is a gigantic incubus on everything like work. In proof of what I say, let me give you a sample of its working. I have a tract of land which I believed to contain valuable minerals, and some time ago, I, acting under the advice of a mining engineer, proposed to explore my land by boring. I learned this could be done in two ways—one by the power of men, which is slow, the other by the power of steam, which is the quick way. Of course, I chose the quick way, but here the patent law stopped me. I found the steam-boring apparatus was patented, and I must buy it from the patentee or his licensees, paying them enormous profit, or be content with the old way. Surely this is a great grievance, but that is little to what followed. When I had gone through all the trouble and all the expense of exploring, sinking pits, and bringing the minerals to the surface, I found I could not use them to the best advantage. A patentee steps in, and says, "You shall not use my process without paying me." Now, surely there never was such an absurd law as this. Was there ever anything so un-English as a law to prevent a man doing what he likes with his own? I could multiply examples, but I think I have said enough to show the senselessness and injustice of the patent law. I am, &c.

Anti-Schemer.

MISCELLANEOUS.

Royal Institution.—Tuesday, January 5, 3 o'clock, Professor Tyndall, "On Electricity at Rest and Electricity in Motion."—Juvenile Lectures. Thursday, January 7, 3 o'clock, Professor Tyndall, "On Electricity at Rest and Electricity in Motion."—Juvenile Lectures.

Pharmaceutical Society.—The next Pharmaceutical meeting will take place on Wednesday evening, the 6th of January, at Eight o'clock. The chair will be taken at half-past Eight precisely. The following papers will be read:—"Note on the Root-Bark of Calisaya." By John Eliot Howard, F.L.S. "Note on *Cassia moschata.*" By Daniel Hanbury, F.L.S. "On Goa Powder." By Mr. David S. Kemp. "Note on the Recovery of Essential Oils from their Watery Solution." By Mr. T. B. Groves. Thompson's Patent Bottles, and Thonger's Patent Label for the Prevention of Accidental Poisoning, will be exhibited at the meeting.

Alkali Works.—On the 1st inst., the Act passed in the late session for the more effectual condensation of muriatic acid in alkali works, will take effect. The object of the statute is to secure the condensation of the gas to the satisfaction of the inspector or sub-inspector appointed under the Act. If it should appear to the court before whom any proceeding for the recovery of a penalty is instituted, that 95 per cent. at least of the muriatic acid gas evolved has not been condensed, a penalty not exceeding 50*l.* will be levied, and for a second offence 100*l.* The owner is to be liable for the offence in the first instance, unless he prove that the offence was committed by some agent without his knowledge, in which case the agent, &c., is to be liable. We have not yet seen the inspectors and sub-inspectors gazetted.

Talmi Gold.—A beautiful gold-coloured alloy, sold under the above name, gave, on analysis, the following results:—

Copper	86·4
Zinc	12·2
Tin	1·1
Iron	0·3

The iron was probably an accidental ingredient. The alloy besides was very thinly gilt. It is a good deal used to make watch-chains.—*Centralblatt*, No. 52, 1863.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

F. Ruschhaupt (Berlin), shall receive a private communication.

M. P. S.—The suggestion shall be attended to.

Assistant.—A solution of borax is used.

A Subscriber.—We know of no work specially devoted to the chemistry of explosive compounds.

E. Fontanella.—There is a practical work on oil refining, we believe, among the series published by Roret, Paris.

Books Received.—Culley's "Handbook of Practical Telegraphy;" "Spectropia;" "The Dircksian Phantasmagoria;" Braithwaite's "Retrospect;" Hardwich's "Photographic Chemistry," new edition.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Volumetric Estimation of Manganese, Antimony, and Uranium; and on some Compounds of these Metals, by M. Antony Guyard.*

(Concluded from page 293, Vol. VIII.)

Estimation of Antimony.—The method I propose is rapid and exact; it depends upon the following facts:—

1. Whatever may be the compound of antimony to be assayed, it must be separated from all the bodies which usually accompany it, and converted into sesquichloride of antimony; if dissolved in sulphide of ammonium, the solution is supersaturated with hydrochloric acid and boiled.

2. In a dilute and very acid liquor, permanganate of potash instantly transforms the sesquioxide of antimony into antimonic acid, the reaction being exactly represented by the following equation:—

$$5Sb_2O_3 + 2KO,Mn_2O_7 + 6HCl = 5Sb_2O_5 + 4MnCl + 2KCl + 6HO.$$

3. During the peroxidation of the antimony, the solution of permanganate of potash is decolorised; but as soon as the reaction is complete, a drop of the permanganate communicates the usual roseate tint.

Operation.—The compound to be analysed is to be dissolved by appropriate reagents; that done, the solution is supersaturated first with ammonia, and then with yellow sulphide of ammonium. When all the antimony is dissolved, the solution is filtered, and an excess of hydrochloric acid is added to the filtrate. The sulphide of antimony is precipitated with sulphur. It is left in a warm place for the precipitate to settle, and the greater part of the liquor is decanted. A large excess of hydrochloric acid is then added to the mixture, and the whole is boiled until all the sulphuretted hydrogen is got rid of. The solution is then filtered, to remove the sulphur, and the filtrate is diluted with about a litre of water. Sufficient hydrochloric acid to make the solution perfectly limpid is then added. The quantity of acid besides must be sufficient to keep the oxide of manganese from the permanganate in solution, and also the antimonic acid, which is less soluble in diluted hydrochloric acid than the sesquioxide of antimony. A solution so prepared is ready for the permanganate of potash, which must be added with the usual precautions, until the rose colour is obtained.

The solution of permanganate should be of such a strength that 30 or 35 cubic centimetres will represent one gramme of antimony. To titrate the solution I use either a sulphide—the exact composition of which I know—or tartar emetic, dried at 100° C. The latter salt is very convenient for the determination, because of its unalterability, and the ease with which it can be prepared quite pure. Although this salt is very soluble in water, and remains quite clear, it is necessary to add hydrochloric acid before the permanganate, because, under such circumstances, the tartaric acid does not act on the permanganate for a considerable time, and, consequently, does not interfere to prevent the desired result.

The above process is capable of very general application. It may be applied with equal certainty to the analysis of antimony of commerce; to the alloys which the metal forms with arsenic and all other metals (tin excepted); to the oxides of all degrees; to all the salts, organic and inorganic; to the natural sulphides; and to the multiple sulphides which antimony forms with iron, nickel, copper, lead, and silver; and, finally, to the direct determination of antimony in the sesquisulphide, which is never obtained perfectly pure in the analysis of antimony by the ordinary method.

Lastly, I have been fortunate enough to rectify, by this process, an analysis of sulphide of antimony from Borneo, very like the ordinary sulphide, but which the analysis showed to have the following composition:—

Antimony	76·10
Sulphur	23·60
Gangue	0·30
	100·00

a composition which corresponds to the formula—Sb_4S_5.

Estimation of Uranium.—The estimation of uranium by weight presents no difficulty; having occasion, however, to analyse a great number of uranium minerals, I felt the want of a rapid and certain method, and, after numerous attempts, I adopted the following process, which perfectly answers the purpose:—

1. The uranium is separated from all the bodies which ordinarily accompany it, and which will interfere with the estimation, by following the process which I shall give presently.

2. The acid phosphate of sesquioxide of manganese forms, in acid solutions of acetate of sesquioxide of uranium and ammonia, an insoluble triple phosphate of ammonia, uranium, and manganese of constant composition.

3. The precipitate appears white, with a yellowish shade, as long as the precipitation lasts, but when this is complete the precipitate has a rose colour, with a dash of bright yellow.

Operation.—A gramme or a gramme and a-half of the salt or ore to be assayed is dissolved in nitric or hydrochloric acid, or *aqua regia*. The solution is then supersaturated with carbonate of ammonia, which separates sesquioxide of uranium from metallic oxides, earthy, and alkaline-earthy, which so often accompany it. In many cases this operation suffices; but if the ore contains phosphorus, or arsenic, or an oxide soluble in carbonate of ammonia, the uranium must be precipitated by ammonia and sulphide of ammonium in the state of protoxide, and filtered. The residue of protoxide of uranium is dissolved in carbonate of ammonia, and then transformed into the acetate of sesquioxide. In any case the uranium is brought into this latter form. That done, the solution is diluted with about a litre of cold water, and then the standard solution of phosphate of manganese is gradually added from a burette, until the whitish precipitate of phosphate of uranium, manganese, and ammonia, appears rose coloured.

Preparation and Titration of the Normal Solution of Phosphate of Manganese.—To prepare this solution, phosphorus is acted on by nitric acid, and, when the phosphorus is dissolved, the solution is evaporated, in a platinum capsule, to a syrupy consistence. Sesquioxide of manganese, in fine powder, or any oxide of manganese, is then added by degrees, stirring frequently. The mixture is then heated for some time, and when the fused mass assumes a blue tint, and the phosphoric acid begins to volatilise, it is allowed to cool. It then becomes purple, and, if dissolved in water, it forms a purple solution very like the solution of hypermanganate of potash. This solution is diluted so that thirty cubic centimetres shall represent one gramme of metal. To titrate this solution, we use the oxide of

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* Communicated by the Author.

uranium U_3O_4 very pure, or the protoxide. To prepare the latter easily in a state of purity, it is only necessary to fuse an oxide, or any pure salt of uranium, with four or five times its weight of a mixture of equal parts of cyanide of potassium and carbonate of potash. The fused mass is first washed with a solution of sal-ammoniac, and then with pure water. The residue dried out of contact with the air is the pure oxide of uranium UO, unchangeable in the air if prepared at a sufficiently high temperature.

Remarks.—1. The tinctorial power of the phosphate of manganese is very weak; a drop of even a concentrated solution will not give a rose colour to much water. In the determination of uranium by means of this liquid, a curious circumstance happens. The triple phosphate of ammonia, uranium, and manganese which is precipitated is really formed of white phosphate of uranium and ammonia, and rose-coloured subphosphate of manganese. As long as there is uranium in solution, the rose colour of the subphosphate of manganese is completely hidden; but as soon as all the uranium is precipitated, the rose colour appears.

2. The solution of phosphate of manganese is really only a solution of subphosphate of manganese in an excess of phosphoric acid.

On the Suboxides of Uranium.

In attempting to reduce the salts of uranium by means of zinc, in order to reduce them to the state of protoxide UO, and then to determine the uranium by means of permanganate of potash, I found that I did not obtain exact results; and that, according to the quantity of pure zinc used in the reduction of the salts, the *titre* of the solution advanced, and that it was necessary to use much more of the solution, as the amount of zinc was increased. In fact, the zinc at first reduced the salts of peroxide of uranium to salts of protoxide; but, if the reduction is continued, a suboxide U_2O is found, which, in its turn, is reduced by the action of zinc and hydrochloric acid to another suboxide, U_3O_2.

Properties.—The suboxide U_2O gives, like the protoxide UO, a bright green solution; but, while ammonia precipitates the protoxide in the form of a violet-coloured hydrate, it precipitates the suboxide U_2O as a bright green hydrate. Further, when the protoxide is completely transformed into the suboxide U_2O, the first effect, with an excess of zinc, is to precipitate the latter oxide in the form of a bright green powder, which is deposited upon the zinc, and redissolves in acids with its peculiar colour.

When the suboxide U_2O is reduced with an excess of zinc, and care is taken to have enough acid to keep it in solution, the bright green liquor soon becomes of a very deep hyacinth red. Ammonia determines, in this solution, a bright green precipitate, consisting of the suboxide U_3O_2, differing from the former by the hyacinth red colour of its solutions. These suboxides are very unstable, and if kept in the air, whether in solution or not, they rapidly pass into a higher state of oxidation.

To analyse these oxides, I reduced, with great care, a known weight of protoxide of uranium, and peroxidised them by means of a standard solution of permanganate of potash, prepared for the purpose, and containing a known weight of the pure and crystallised salt. The amount of solution required was found to be in an inverse ratio to the amount of oxygen combined with the uranium, and in this way, after some inevitable disappointments, I found that it was possible to arrive at sufficiently exact results.

Uranic Acid.

The nitrate of the sesquioxide of uranium does not combine with nitrate of silver when a mixture of these two salts is precipitated by potash. We only obtain a dirty grey mixture of the two oxides.

But, on the contrary, if we introduce recently precipitated oxide of silver into a solution of nitrate or any other salt of uranium, and heat the mixture a little, a part of the oxide of silver is substituted for the oxide of uranium; and this latter, in depositing, combines with excess of oxide of silver, forming with it an amorphous compound of a magnificent orange-red colour. The formula of this compound is $AgO,2(U_2O_3)$, and it may be called the *uranite of silver;* in composition it exactly resembles the alkaline uranites.

If, however, we invert the order of the experiment—that is to say, if we precipitate the oxide of the nitrate of silver by means of sesquioxide of uranium or an alkaline uranite, and heat the mixture, a brilliant black crystalline powder is soon formed, the formula of which is $AgO,2(U_2O_5)$—that is to say, *uranate of silver.*

The following equation will represent the formation:—

$$2(AgO,No_5)+KO,2(U_2O_3)=AgO,2(U_2O_5)+KONO_3 + AgONO3.$$

This salt is sufficiently stable to analyse, but I was unable to isolate the uranic acid it contained.

The latter facts confirm the relations between uranium and antimony established by a celebrated chemist; but the theory he has published on this subject does not seem to me sufficient, and I hope soon to substitute another, for which I shall gather together the facts, and extend my experiments.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(Continued from page 249.)

4. **Invention of the Air-pump.**—About ten years after the discovery of the pressure of the air, Otto Von Guericke,* a burgomaster of Magdeburgh, made a number of experiments, with a view of obtaining a larger vacuous space than that which could be procured by Torricelli's method; for, although the behaviour of certain bodies in a vacuum had been tried by introducing them into the Torricellian vacuum, this mode of experimenting was obviously attended with numerous difficulties, and but few substances could be placed in a vacuum obtained by such a process.

Guericke conceived that he could effect his object by completely filling a vessel with some substance which could be removed without allowing air to take its place. He, accordingly, filled a wooden cask with water, and fitted into it a syringe, all other parts being closed as securely as possible; he then pumped out the water, expecting that a vacuum would be produced in the cask, but air readily entered, by the crevices, to occupy the space which the water left.†

Having previously observed, however, that air could be made to expand to any extent, he determined to cause air to leave a vessel, in virtue of that property, and to prevent its return by external means. In order to effect this, he took a copper globe, and fitted into it a syringe; when the pumping was commenced, the piston worked somewhat easily, but became more and more difficult to raise, and in a few minutes the globe was compressed with a loud noise.

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* Born, 1602. Died, 1686.

† See "Ottonis de Guericke Experimenta Nova (ut Vocantur) Magdeburgica de Vacuo Spatio." Amstelodami. 1672.

Guericke next procured a glass globe, furnished with a straight brass tube, containing a stop-cock, by means of which free communication with the interior of the globe could be established or prevented; to the lower part of the tube, and inclined to it at an angle of 45°, a syringe, having a solid piston, was adapted. Near the lower end of the syringe, a lateral valve opening outwards was placed, and at the juncture of the syringe with the tube there was a second valve, opening into the syringe. The valve and stop-cock were immersed in water to prevent air from leaking into the apparatus.[‡] It is obvious that, on raising the piston of such an air-pump, the air in the globe will expand, open the lower valve, and escape into the body of the syringe, while the lateral valve will be kept closed by the pressure of the air; and, on depressing the piston, the lower valve will close, and the lateral valve will open to allow the air in the body of the syringe to escape. A good vacuum could be obtained by this instrument, but it required a great deal of pumping to produce it.

Soon after the invention of the air-pump, Guericke constructed the "Magdeburgh hemispheres," a full account of which, Schottus informs us, was first given to him in July, 1656. In Guericke's "Experimenta Nova" there is a picture which conveys to the mind a good idea of the enormous pressure of the air. In the centre of this picture we observe a pair of large Magdeburgh hemispheres, to each of which eight horses are attached, and, although most evidently urged to their uttermost by men, who flourish aloft gigantic whips, they are unable to effect the division of the sphere.

Among other experiments made by Guericke with his air-pump, we may mention the following:—

1. A sparrow placed in the receiver died on exhausting.
2. A candle was extinguished in an exhausted receiver, because, says Guericke, *fire consumes air*.
3. Water was found to rise to a great height in an exhausted tube, and when the exhausted receiver of the pump was opened under water, water violently entered, and almost filled it.
4. A vessel exhausted of air was found to be considerably lighter than before exhaustion.
5. A bell made to ring in an exhausted receiver was inaudible until air had been admitted.

Kircher [§] had previously tried this experiment in the Torricellian vacuum by ringing a bell, the clapper of which was of iron, and was moved by the alternate approximation and withdrawal of a magnet. Kircher states that the sound was distinctly audible, from which we may infer that he suspended his bell within the tube by means of some substance capable of transmitting the vibrations to the tube.

Guericke did not believe the air to be elemental, and considered it incapable of being converted into water.

The following is his definition of air:—

"Aer est nihil aliud quam expiratio aut effluvium, aquarum, terrarumque, et aliarum rerum corporearum."

The science of Pneumatics, which took its rise immediately after the invention of the air-pump, was greatly extended in England by some of that band of experimental philosophers which arose shortly after the death of Bacon. Foremost in that band, if not the very leader of it, was Robert Boyle,[‖] a man who, despising all previous philosophies, applied himself vigorously to carry out the ideas of Lord Bacon. Boyle had the greatest reverence for the "Novum Organum," and there could not be a mind better adapted than his for putting in practice the "new philosophy." He was the very man that was wanted, at a time when speculative philosophy, unaided by experiment, was being changed for experimental philosophy, aided by inductive reasoning.

"But our hope of further progress in the sciences," writes Bacon, in the "Novum Organum,"[¶] "will then only be well founded when numerous experiments shall be received and collected into natural history, which, though of no use in themselves, assist materially in the discovery of causes and axioms, which experiments we have termed enlightening, to distinguish them from those which are profitable. They possess this wonderful property and nature, that they never deceive or fail you; for being used to discover the natural cause of some object, whatever be the result, they equally satisfy your aim by deciding the question."

Now, Boyle was the man to thus promote the welfare of the sciences; he was not one to cultivate them for profit to himself, or for renown, but he chose rather to study science for the pure love of the thing; and such men only have a right to bear the title of Philosopher, and by them alone is science permanently benefited. Bacon was the architect who planned out a glorious structure, and Boyle was one of the master-builders of his day; and he laid the foundation of a part of that building so securely, that it still endures; and although now and then we have to remove a brick which has fallen to decay, we still continue to build on that foundation, and the workmen increase, and the building rises rapidly,—let us hope it may be soon roofed in.

The writings of Boyle extend over a period of thirty years; they are excessively prolix, but with so few previous experiments on most of the subjects, it was difficult to avoid describing the most trivial effects: we must remember, moreover, that he wrote of phenomena hitherto almost unknown to the human mind, and we must overlook the tediousness of the accounts of his experiments, which, although they appear very detail to us, were probably not too much so for his contemporaries.

Boyle's first work on the air appeared in 1661, and was entitled "New Experiments, Physico-Mechanical, Touching the Spring of the Air and its Effects; made for the most part in a new Pneumatical Engine." The entire work is written in the form of a letter to Lord Dungarvan, and is dated December 20, 1659.

So soon as Boyle heard of the invention of Otto Von Guericke's air-pump, he determined to construct one which should be less cumbrous, and should not require to be placed in a vessel of water. He mentioned his wish to his friends, Hooke and Greatorex, and, after several unsuccessful trials, Hooke made for him an air-pump which was considered to be superior to Guericke's. It consisted of a hollow, vertical cylinder of cast brass, fourteen inches long and three inches internal diameter, the lower end of which was open, and the upper closed, with the exception of a small orifice in the line of the axis of the cylinder, and a tapering, lateral orifice, into which a brass stopper, serving as a valve, fitted airtight. A solid piston, to which vertical motion was given by means of a rack and pinion, worked within the cylinder. The receiver[**] was a glass globe capable of containing

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[‡] See "Mechanica Hydraulico Pneumatica," by Gaspar Schottus. 1658. Also, "Technica Curiosa" (1664), by the same Author.

[§] Born, 1601. Died, 1680.

[‖] Born, 1626. Died, 1691.

[¶] Book 1, Aph. 99.

[**] No one can have failed to observe how singularly inapplicable the name of "*receiver*" is to that part of an air-pump which it is desired to *empty* as completely as possible; the name was given by Boyle, who, in speaking of the vessel to be exhausted, says, "which we, with the glass-men, shall often call a receiver, for its affinity to the large vessels of that name, used by chemists."

thirty wine quarts, fitted with a stopcock, the shank of which was cemented into the upper orifice of the cylinder; and in that part of the globe opposite the stopcock there was a circular-lipped opening four inches in diameter, to which a brass ring (diminishing the diameter of the opening to three inches) was cemented; the ring was closed by an "exquisitely-ground" brass plate, containing a half-inch circular orifice closed by a brass stopper, which could be turned, when the receiver was exhausted, without admitting air. The whole apparatus was arranged vertically, so that it was terminated above by the opening of the receiver for the introduction of bodies to be experimented upon, and below by the open orifice of the brass cylinder.

Before commencing to exhaust the receiver, the piston and all the joints were well oiled, the piston pushed to the top of the cylinder, and the stopcock and lateral valve closed; the piston was then drawn to the bottom of the cylinder, and the stopcock opened to allow air to rush from the receiver into the vacuous space; the stopcock was now closed, the valve opened to allow of the exit of the air in the body of the cylinder, and the piston again forced to the top of the cylinder; the same process was repeated until the receiver was exhausted.

I do not consider this first air-pump of Boyle's by any means so ingenious a contrivance as that of Otto Von Guericke. The arrangement of the apparatus was indeed different, but the method of exhaustion was the same, more clumsily effected; the stopcock of Boyle's pump played the same part as the lower valve of Guericke's, and the lateral valve of the former the same as the lateral valve of the latter, with this disadvantage, however, that the valves of Boyle's pump had to be worked by hand, while those of Guericke's were worked by the air.

(To be continued.)

TECHNICAL CHEMISTRY.

Observations on the Sombrero Guano,

y ALEXIS A. JULIEN, *Resident Chemist at Sombrero.*

IN anticipation of a paper on the subject of the guano island of Sombrero, which I hope soon to present, it is proper for me, from my peculiar advantages, to point out some of the errors into which Dr. Phipson* has fallen in his proposal to distinguish the Sombrero guano as a new mineral species.

He commences by saying: "This mineral forms a large portion of some small islands in the West Indies, especially of Sombrero Island." The only other islands in the West Indies, besides Sombrero, on which the rock guano has been found to occur, are Les Monges, El Roque, &c., off the coast of Guiana and Venezuela. The composition of the rock guano, however, from these islands is very variable, and, as the published analyses show, differs materially (except in general character) from that of the Sombrero guano, and altogether from the representative analysis for "Sombrerite" which Dr. Phipson offers further on.

In the course of the brief and very imperfect description of the physical characters of the Sombrero guano given by Dr. Phipson, he says: "It shows no signs of crystallisation whatever, but appears like an amorphous gelatinous phosphate that has been submitted to a high temperature." I have recently, however, discovered in certain localities small but perfect crystals of bone phosphate of lime (together with a small proportion of carbonate of lime and phosphate of magnesia), in the examination of which I am now engaged. Again, there is a natural division of the Sombrero guano into two varieties. One of an oolitic structure, of a great variety of colours, and containing, in addition to the bone ($3CaO, PO_5$) and neutral ($2CaO, HO, PO_5$) phosphates of lime, the phosphates of alumina, iron, and magnesia, organic matter, silica, &c. The other variety, generally of a broad concretionary structure, is of a white or yellowish-white colour, containing a little carbonate of lime, sulphate of lime, &c., but especially abounds in bone phosphate of lime. From these and other evidences, it is almost certain that the former more nearly resembles the original deposit and is the older of the two; while the latter is far more uniform in composition. These varieties are so characteristic that it would be difficult to find a block of this guano of a cubic foot in dimensions in which one or both of them would not be perceptible. The term "amorphous" can only be applied to those comparatively rare varieties in which these characteristics are mixed, or entirely indistinguishable on account of the uniformity in colour of the oolitic grains and their cement. Again, as the guano is interlaminated with ordinary coral limestone, and I have found all the phemonena it presents to be plainly attributable to atmospheric agents, there is no call for the conjecture of a "high temperature," nor for the following strange theory proposed in the latter part of the article:—"I look upon this rock as having found its way to the surface at a high temperature, in contact with water or steam, and under great pressure."

The "several kinds of shells," which Dr. Phipson then mentions among the fossils enclosed in the guano, belong entirely to the coral limestone which is very generally converted into phosphate of lime, wherever it is in contact with the masses of guano, or has been exposed in the veins to percolating guano solutions. The only synchronous fossils of the guano, yet discovered, are a variety of bones, the shells of a crab, rootlets, and a small coral.

As a representative analysis of "Sombrerite," Dr. Phipson offers that of "a well-chosen specimen"—the absurdity of which expression will be understood from what has been already stated. The Sombrero guano is as variable in composition, particularly in its content of earthy phosphates, as any other phosphatic guano, and as little entitled to rank as a new species. Dr. Phipson cannot possibly have examined with any care a single cargo—I venture to say, not even a single ton; for there is no natural standard by which a representative specimen could be "well-chosen" or chosen at all.

Further, Dr. Phipson does not inform us of the methods used by him in his analysis. This omission is unfortunate when we take into account the prevailing uncertainty among chemists as to the most exact mode of estimating phosphoric acid, in the presence of lime, iron, and alumina, also on account of some other curious results arrived at. Firstly, as to the 9 per cent. of water: it is to be presumed that the "well-chosen specimen" was carefully dried to remove moisture, which varies several per cent. in different varieties. It is also to be presumed, from the analysis, that "Sombrerite" contains no neutral phosphate of lime, with which a part of this 9 per cent. of water may be combined,† and that the two equivalents of water, combined in the

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* *Vide* CHEMICAL NEWS, vol. vi., p. 48.

† Notwithstanding that the presence of phosphoric acid in the filtrate, after long washing with hot water, has proved the existence of this salt in at least some common varieties.

"sulphate of lime," have been deducted from the gross amount. The variety of this guano which I have described as of concretionary structure especially predominates throughout the southern part of Sombrero Island, and over one-half our cargoes are composed of it. It contains on an average 83 to 85 per cent. of bone phosphate of lime—less than one per cent. of phosphate of alumina, and often none. We may very properly ask if this fact is to be entirely ignored in the consideration of the composition of "Sombrerite?"

The article concludes with the following objection to the use of this guano in the manufacture of superphosphate of lime:—"In producing the latter, Sombrerite gives rise to a certain quantity of sulphate of alumina, and this salt, being deliquescent, attracts and retains so much moisture that the product can be dried only with great difficulty"—an objection applicable with the same force to the 1·44 per cent. of similarly deliquescent chlorid of sodium. But every practical Chemist is aware that in this manufacture only a portion of the phosphate of lime of the material is ever intentionally and actually converted into superphosphate. It cannot be that Dr. Phipson supposes that this "sulphate of alumina" can be formed and exist in the presence of an excess of bone phosphate of lime. Finally, he has but to consult that same "manufacturer of superphosphate of lime" to learn how utterly groundless is his objection in fact as well as in theory.

Such of these observations as depend merely upon my own statement I shall hereafter more fully elucidate. We may safely conclude that a material so heterogeneous as the Sombrero guano does not possess the uniformity of composition requisite for distinction as a mineral species.—*American Journal of Science*, xxxvi., 424.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture II.—*Saturday, December* 12, 1863.

Ladies and Gentlemen,—In the lecture which I had the honour of delivering to you the day before yesterday, we considered the subject of silicon, one of the chief components of the solid crust of the earth. This silicon has only of late been carefully studied. It is certainly one of the most remarkable and important elements which we possess. It occurs, you will remember, in three distinct forms; and if you will allow me, although at the sacrifice of a little time, I will write them down, in order to make the matter perfectly clear. First, we have the pulverulent state, or amorphous condition of silicon, which is extremely divided, and perfectly non-crystalline. It is in the form of a chocolate brown powder, and it is, indeed, only recently that we have seen silicon in the crystallised state. We have it next in what is termed the graphitoidal state, or state resembling graphite. It occurs in the production of aluminium, or, at all events, it was first discovered in the making of aluminium by a particular process. It appears in the form of six-sided prisms, having a more or less metallic lustre, and a dark bluish-black colour. Then we have what is termed the octahedral form of silicon. In many characteristics it is very similar to the graphitoidal. In colour, for example, you can hardly distinguish the two. It crystallises in the regular cubical system to which the regular octahedral belongs.

Now, it is a curious thing that there is a remarkable analogy between silicon and carbon. Every chemist knows that there are very small chemical relations existing between the two, but with regard to the particular states in which the elements occur we find an analogy obtaining. Thus, we have common charcoal, which is the amorphous or non-crystalline form of carbon. We have the amorphous or non-crystalline form of silicon. We have the graphitic form of carbon exactly corresponding to the so-called graphitoidal form of silicon. Lastly, we have the diamond, which is the crystalline form of carbon, and corresponds exactly to the octahedral form of silicon. In fact, silicon in this state has been called the silicon diamond.

It is not my business on the present occasion to describe how this silicon can be obtained. That belongs rather to a purely chemical investigation. There is a compound well known to chemists, called silico-fluoride of potassium or sodium. You saw the gas which I generated here on the last occasion,—the transparent, colourless gas, consisting of the two elements, fluorine and silicon. Well, those two elements combine with potassium or sodium, forming a definite white salt—silico-fluoride of potassium or sodium. If we bring in contact with that salt some sodium or potassium, and also add a little common zinc, and heat the mixture, silicon is separated—displaced from its combination with fluorine by the sodium, and is immediately caught by the metallic zinc. We have here a specimen of sodium. It exists in our common salt, and is a beautiful, bright, shining metal. The temperature should be such as to keep the zinc in a molten state. The silicon so separated dissolves in this molten zinc, and, on solidification, it separates more or less completely from the metallic mass in a definite, beautiful, distinct crystalline form, the silicon being dissolved through the mass of zinc. All we have, then, to do is, to operate upon that zinc by means of common spirits of salts,—common hydrochloric acid, which dissolves the zinc, and leaves the silicon unacted upon. In this way these crystals before you were obtained. Notwithstanding the powerful affinity of silicon for oxygen, and the great exercise of force which it requires to separate the oxygen from the silicon in the state in which they are combined in silica, yet, when the silicon is separated, it is astonishing how remarkably stable it is. There it is. It may be exposed to the air for an indefinite time without undergoing the least change. You may heat it, indeed, to a very high temperature, even with access of air, yet it shall not be oxidised. You may expose it to the action of various strong chemical reagents, and yet it shall undergo no change. Well, now, it strikes us as extremely remarkable that a body which possesses such a strong affinity for oxygen, and requires the exercise of so much force to separate it from oxygen, should be so stable when separated as we find it to be. Exposed to a high temperature it fuses. Here is a specimen of this fused silicon, for which I am indebted, as I said in the last lecture, to Mr. Matthey, of Hatton Garden. We have it again here in a small quantity, but nothing to the extent which you see in the other specimen. This silicon is now playing a very important part in certain metallurgical operations. I just mention this incidentally. For instance, in the smelting of iron we find pig iron produced in various furnaces containing a considerable portion of silicon. I have known sometimes even as much as 8 per cent., and there is frequently 3 or 4 per cent. The presence of it in iron modifies the properties of the latter considerably. It combines readily enough with copper. If we take a little copper or iron in a more or less divided state, say in the form of filings, and mix these filings with common sand, which, as you know, is a compound of silicon and oxygen, and add an excess of charcoal, making a mixture of the three, and let the amount of charcoal and sand be such that, when we expose the mixture in a crucible to a high temperature sufficient to melt the copper or the iron, as the case may be, there should be sufficient of this mixture to retain the metal diffused through the mass, and then expose the mixture to a high temperature for a few hours—

all the silica, under the conjoined influence of the carbon and the metal, is decomposed, the carbon laying hold of the oxygen, and escaping in the form of carbonic oxide, and the silicon is set free, combining with the metal. Well, here is a piece of common copper which was treated in this way—heated with sand and charcoal for a long time. The metal has undergone a great change in its external appearance. It has no longer the red colour of copper, but has the appearance of bronze, which is a mixture of copper and tin. It is so like the bronze of which our guns are composed, that an inexperienced eye would not distinguish the one from the other when they are side by side. It is a very valuable alloy, so that you see that silicon may play a very important part even in the common arts of this country. I might give you another illustration of the fusion of silica. Platinum is a metal which requires a very high heat for its fusion. Now, if we heat silicon in contact with platinum at a high temperature, no change will take place. Here is an illustration of this fact. The platinum has undergone no change of form even in its thin edges; but let us add a little bit of charcoal, and then repeat the experiment. The silica instantly becomes reduced under these conditions, and the silicon set free combines with the platinum, forming this very fusible compound.

Having made these remarks, we may pass on to give just a *résumé* of what we said the other day with regard to silica, and it shall be exceedingly short. Silica, as we have seen, is a compound of oxygen and silicon. It exists in two very distinct states with regard to specific gravity. I am afraid that the way I put that matter before you in the last lecture may have led you to a wrong conclusion on the subject; therefore, with your permission, I will say a word or two more about it. We will divide silica into two distinct kinds. I have called the first heavy silica, having the specific gravity of 2·6. Then this is subdivided into two distinct varieties—namely, rock crystal, about the crystalline character of which there can be no mistake, and sand, which is nothing more than finely divided crystallised quartz. We have, as I told you, another variety of heavy silica of the same specific gravity, which to the eye is apparently wholly non-crystalline, but which Rose maintains, or rather designates, as crystalline, supposing it to be built up of excessively minute crystals. Under this head, we have chalcedony—of which you have a beautiful specimen before you—chrysophrase, flint, and hornstone, and I might mention other varieties, but these will suffice. All these belong to the class of heavy silica. The second division is the so-called light silica, the specific gravity of which never exceeds 2·3; and this light silica is always perfectly amorphous. It may occur even in the form of jelly, as you saw it last time, or as a perfectly non-crystalline powder, or like so much glass melted and deposited on the surface of a mineral in the form of hyalite or opal. Now, as I pointed out to you, these distinctions are exceedingly important in their bearing upon that portion of geological science relating to the formation of certain igneous rocks, of which silica is known to be an essential constituent. Then there is another distinction. The heavy silica polarises light; light silica never does; and that is a very important distinction, and one founded on essential structure. Heavy silica, so far as we know, is always produced in the wet way, that is, through the intervention of liquid reagents. This we know by direct experiment, and we have also the inferential proof, founded upon specific gravity, to which I have just directed your attention again. Then the light silica may be produced in two ways—either by separation from its compounds in the manner I showed you last time, or by fusion, all fused silica having a low specific gravity never exceeding 2· .

I will now say a few more words concerning the proofs—the mineralogical or geological proofs—(no matter which word I employ), relating to the aqueous origin of crystallised silica, and they are very conclusive. Let us look at our mineralogical cabinets, and examine the specimens of quartz which we find therein. I have one here before me, a very small one, which, unfortunately, cannot be seen by the audience at large; but if I come to examine this quartz minutely, I find that it surrounds a mineral called hæmatite, consisting of peroxide of iron and water. It is a mineral which loses its water at a very low temperature. There it is, embedded in the quartz, clearly showing that the quartz never could have been exposed to a high temperature. Here is another mineral, carbonate of iron, embedded in the quartz, and the existence of this and the peroxide clearly shows that that quartz never could have been exposed to a high temperature, and supports the conclusion at which we have arrived touching its aqueous origin. Then we find incrustations which lead to the same conclusion.

With regard to amorphous silica there is no doubt whatever about its aqueous origin. We can trace its origin in the clearest and most distinct way. In Iceland, for example, it is abundantly produced in the geysers. Here is a specimen which has been obtained from that source. Then, again, here is a specimen of granite from Iceland. on which is deposited a thin film of silica, having a pearly lustre. There is no one who will venture to say that that could have been thrown down on to the granite except by the agency of water. The specimens are very small in themselves, but, nevertheless, they speak very eloquently of the origin of silica, and tell an important tale, small as they are. Here is a very characteristic specimen showing the occurrence of crystalline quartz in two states on the very same portion of this mineral. One state is the chalcedonic, or apparently non-crystalline. I use the word *apparently*, because the substance has been found to be composed of minute crystals. Close in contact with this is the other state, which is more or less non-crystalline; and then occurs a sort of granite deposit, which, seen under a magnifying glass of high power, is seen to consist of distinctly crystalline quartz. Amorphous silica exists in the shells of living infusoria; and it is found also in a siliceous concretion, met with in the joints of the bamboo, known as tabasheer. It occurs also in petrified wood.

I will say just a word or two on the subject of flint—a subject which has recently given rise to so much discussion. You are all acquainted with the discovery of those wonderful pieces of flint and chalk, the formation of which is involved in doubt, notwithstanding that they are associated with the presence of sponge, and so on. There are, however, chemical difficulties which arise, and which will require much time to solve completely. When we take one of these dark flints, and expose it gradually to a temperature which we bring at last to a bright redness, it becomes very tender and fragile, and it would become especially fragile and perfectly opaque if heat were rapidly applied. It is in this way that the flints prepared for the use of potters are rendered fragile in the first instance, preparatory to grinding. Now, when we examine specimens of flints we are frequently struck with an opaque white outer film, where the flint has lain in contact with chalk. This film, or rind, if I may so call it, extends to a considerable depth. Well, what is it? Is there any chemical difference between this white rind and the inner dark portion of unchanged flint? This is a question which we have examined with some care, and by the aid of the most careful chemical analysis we are unable to detect any sensible difference between the two. The only conclusion, therefore, is, that the difference of appearance is owing to some molecular change, but how it is excited I am not prepared to say—whether by the slow operation of time, or whether, perhaps, by simple vibrations. It has often struck me, with regard to the flints which I have seen on the sea-shore, which have presented a white appearance, that possibly that appearance may have been caused by some operation of that kind; but upon that point I speak with the greatest possible reserve. It is of very great importance to know exactly the effect of weathering upon the surface of flints, especially with regard to the great question now agitating the public mind concerning primeval man. Here is one of those wonderful things hewn out of flint by our rude forefathers, for the loan of which I am indebted to my friend, Dr. Falconer. It presents a fracture at one end, which is very different from the contiguous portion; but then at another portion I observe the characteristic dark appearance of some of these ordinary flints. I have been examining this specimen, and upon the whole I think it must have been long exposed, subject to some condition by which the surface has been changed. Then comes the question—whether it is possible to imitate these signs of age upon counterfeits of ancient flint implements. I think a few experiments would very soon settle the point whether it is possible to give a surface very much resembling that which we find in these old weapons, by some chemical means.

With regard to the permeability of these flints by liquids, it is astonishing how pervious they are. If we immerse flint in sulphate of indigo and water, and keep it there some weeks, the indigo will penetrate to some depth.

It has been alleged, and it is a point of some importance, that silica may be volatilised, especially by the agency of steam. Every chemist knows that boracic acid, which is a fixed body, may, by the agency of steam, be vaporised to a considerable extent. A case of the volatilisation of flint was recorded, some years ago, by Mr. Julius Jeffreys. It occurred in a potter's kiln in India. His statements have been repeated by many journalists, both British and foreign. It is important that we should examine the ground upon which he arrived at his conclusion. He allowed a large quantity of steam to pass through a potter's kiln, of which the temperature more than sufficed to melt pig iron, and he afterwards observed round the opening of the kiln from which the steam escaped, several pounds of silica deposited in the form of snow. In commenting upon this statement, Berzelius, who accepted it, adduces, as a parallel case, the well-known volatility of boracic acid under the same conditions, and the fact observed by Gaudin concerning the volatilisation of silica when melted before the oxy-hydrogen blow-pipe. Now, I have examined all the original statements concerning this allegation, and I must say that the conclusion to which I have arrived is, that it is altogether unsatisfactory. There is no proof whatever, or, at all events, there is none advanced, that the deposit was silica at all. No analysis was made, and no man is justified, without the evidence furnished by analysis, in pronouncing definitely upon a point of this kind. Secondly, admitting that the substance called silica was really silica, there is no evidence to show that it was volatilised in the way described. We perfectly well know that in metallurgical operations a very large amount of finely-divided matter may be carried to a very long distance mechanically by gases or vapours floating over it. Volatilisation is something different from the mechanical removal of the particles of a substance.

I shall have occasion, when we come to speak of metamorphic action, especially of igneous rocks and so forth, to allude to silica in a state of combination.

The subject we now take up is one of great interest, which I think you will admit by-and-by, at all events. It is aluminium. This aluminium plays a most important part in this world so far as the formation of the crust of the earth is concerned. It is, as I have said, one of the chief constituents of, and forms an essential part of, all clay. It exists almost everywhere in a greater or less proportion. It is undoubtedly one of the most beautiful elements of which this world is formed, or the external part of it, rather.

Aluminium has of late excited a great deal of attention. Formerly it was known only very imperfectly, a few grains only having been obtained Now it is produced by the hundred-weight. I have here placed before you a slab of aluminium. The metal has a bluish-grey colour. To my eye, it is intermediate between tin and zinc in point of colour, being not so white as tin, and less blue than zinc. It is by far the lightest of all metals now used in the arts, its specific gravity being in round numbers 2·5; that is to say, whatever measure of water weighs 1, the same measure of aluminium will weigh 2·5. A pint of water, we will suppose, weighs one pound, and a pint of aluminium would weigh two pounds and a-half. It is a malleable metal. It can be drawn out by rolling, or extended under the hammer with proper precautions, or drawn into wire —nay, even beaten out into thin leaf. Here is some of the leaf, and all contained in this bottle weighs only one grain. It is very fusible, but has a higher melting-point than zinc. It is very sonorous. When suspended, for example, by a string, in this way, and struck, it will ring like a bell; but when cast into the form of a bell it has proved a most signal failure. This metal alloys with several other metals, but there is only one really useful alloy which has been made with it, and I think I may say that the first bit was made in this place. It alloys with copper without the least difficulty in the proportion of about 5 per cent., and produces an alloy so like gold in colour, that even a goldsmith would fail to distinguish between real gold and the alloy of copper and aluminium. I have tried the experiment with men of experience, and they have been puzzled to say which was which. This alloy is very ductile, and is capable of a very high polish. There is one mistake prevalent in the public mind with reference to this alloy, or, at all events, an attempt has been made to mislead the public on the point. It is said that it will not tarnish. That is a mistake. It tarnishes rapidly enough, especially in our atmosphere. It is also said to have no odour; but to my taste, at all events, it certainly has distinctly the savour of copper.

Now, aluminium has a most powerful affinity for oxygen. When combined with that element it constitutes the well-known base, alumina. Like silicon, although it has this strong affinity for oxygen, yet when we succeed in detaching it from oxygen, and obtaining it in a compact, solid form, it is remarkably stable. That piece of aluminium might be exposed indefinitely to the air without undergoing oxidation to any extent. When melted, it oxidises on the surface, and forms alumina. This acts as a coating, and protects the subjacent molten metal from further oxidation.

I may just say a word or two about the mode of the formation of aluminium, because it may be interesting in other respects. It is made from a salt termed chloride of aluminium. If we take alumina, which is aluminium and oxygen, and heat it with charcoal even to a high temperature, we cannot, so far as we know, succeed in eliminating the oxygen and detaching the aluminium; but if we make the salt called chloride of aluminium, then we can, by means of a metal having a powerful affinity for the chlorine, succeed in separating the aluminium completely. The first process was to take aluminium and mix that with charcoal, and then to make the mixture into small pellets, such as you see here. Here is some alumina, and here are some pellets so made of charcoal and alumina. Now, that charcoal at a high temperature has an affinity for oxygen; and if we expose that mixture of alumina and charcoal at a certain degree of heat to the action of chlorine, we then get chloride of aluminium. We have then two affinities coming into play. We have the affinity of the oxygen for the carbon, and the chlorine for the aluminium, and by means of this twofold force we form this body, having a yellow colour, and commonly called chloride of aluminium. Well, we then place that chloride of aluminium in a glass vessel, which was the way it was formerly prepared, and expel the air by means of a hydrogen gas, and then introduce the vapour of sodium by a new application of heat to the exterior, in contact with the vapour of the chloride of aluminium. The result is the formation of chloride of sodium or common salt, and the separation of the metal which you have now before you. To describe this process properly would require diagrams, and occupy an hour and a-half. There is one other source of aluminium from a curious mineral called cryolite—one of the highest possible interest. Here is a specimen from Greenland. This consists of the elements fluorine, aluminium, and sodium. Well, to any mineralogist and chemist who reflected upon its composition, it would naturally occur that, if we could bring that substance into contact with sodium at a high temperature, we should produce aluminium. The thought occurred here some time ago, and I believe that the very first specimen produced was produced in this place. That specimen is now before you. It was shown some time ago at the Royal Institution. By the means I have spoken of we get globules of aluminium.

Now for alumina. Alumina is, as I have said, a compound of oxygen and aluminium. It contains, in round numbers, 53·3 per cent. of aluminium, and, consequently, 46·7 per cent. of oxygen, and its chemical symbol is Al_2O_3. When dry, it forms a white, tasteless powder, insipid and insoluble. Here is a specimen of it. This powder is fusible only at the very highest temperatures we can command. In fact, it is singularly infusible. In that state it is entirely amorphous. It has the property of combining with water in several proportions, producing a plastic, clay-like mass. Compounds of this kind occur in nature. One hydrate—that is to say, one water compound of alumina—occurs beautifully crystallised. That is the well-known diaspore. Then we have a non-crystalline variety in the form of Gibbsite. This diaspore is a compound of 1 equivalent of alumina and 1 of water. Gibbsite, of which you have a specimen before you, is a white, amorphous, or non-crystalline body, and is a compound of 1 equivalent of alumina and 3 of water.

Alumina crystallises magnificently, producing that glorious mineral (excuse the emphatic expression, for I think it is one that is perfectly justified) called corundum, which, when blue, is known to you as sapphire, when red as ruby, when yellow as oriental topaz, and when green as emerald. We have here a specimen of corundum which is coloured, forming these various minerals respectively. We shall speak of the mode of formation presently.

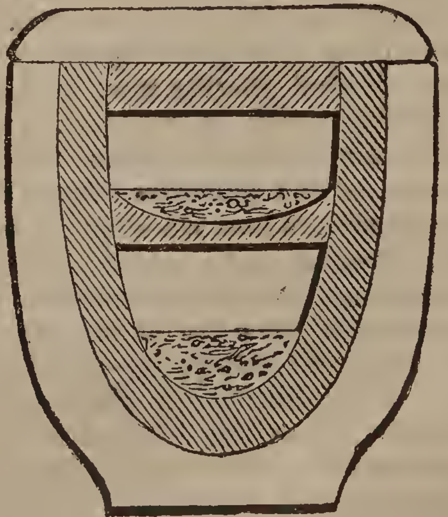
Alumina acts in the two-fold capacity of base and acid —that is to say, it unites with acids forming definite salts —and it also acts as an acid forming definite salts. It appears as common alum in the first of these states. If we take the well-known base, magnesia, or lime, or oxide of zinc, and mix them with alumina in certain proportions, we get the minerals called spinels, the alumina acting as silica would under corresponding circumstances.

There are various salts of alumina in nature, of which we shall speak presently. One of these is wavellite, or phosphate of alumina. Alumina may be precipitated easily by taking a soluble salt of alumina, dissolving it in water, and adding a little ammonia to it. It then forms a dense white precipitate. In that state it is combined with water. It is perfectly soluble in caustic potash, combining with it, and forming a clear solution.

As far as we know at present, it does not appear that the process of dialysis can have played a very important part with regard to the formation of alumina in nature, or rather in the separation of alumina. Professor Graham has spoken of the dialysis of certain salts of alumina. For instance, one of these is basic acetate of alumina, which may be decomposed by dialysis. The chloride of aluminium is another. There is, however, a salt which he has not examined at present. That is the sulphate, and that is the most likely of all to occur in nature. Therefore, for the present we have no reason to suppose, from the experiments reported, that this process has any applicability to the formation of alumina in nature.

Now, let us look at crystalline alumina. This is a subject which has a bearing upon geological phenomena. A minute crystal found in a rock shall be a clear exponent of the formation of that rock. However small it may be, it shall tell a most eloquent and indisputable story with reference to its origin. Now, I think you will agree with me that what I say is really not overstated with regard to the formation of some of the mineral constituents, though occurring in small quantity in some of our so-called "igneous" rocks.

The late distinguished, most excellent Professor Ebelmen made numerous experiments upon the subject of artificially crystallised alumina. I hold in my hands specimens which I received from him years ago. They are exceedingly small, but remarkably characteristic. Here are some small scales of alumina crystallised by the operation of fire. The process consists of heating alumina, mixed with about three or four times its weight of borax, in a small platinum crucible, under certain precautions, in a porcelain furnace—a porcelain furnace where we obtain hard porcelain, and not the so-called porcelain which we make in this country, and which is made at a low temperature. It must be the true Chinese porcelain furnace, such as was in operation at Sevres, where he experimented. He exposed the borax and alumina at a high temperature in this furnace. The borax dissolved the alumina, and after a time off went the boracic acid and the sodium. The crystallised alumina remained at last in brilliant colourless scales. These are some of those obtained by M. Ebelmen. This is exceedingly similar to what is obtained at ordinary temperatures with liquid solvents at our command. It is only just to the memory of poor old Berthier, who died not long ago, to state that I find, in looking over his papers, that he really was the first man to adopt this mode of forming mineral substances, and obtaining them in a crystallised state. He did not use borax, but he used an equivalent, namely, common salt. He formed crystallised silicate of lime and magnesia by exposing them with salt on precisely the same principle as when borax is used. We are indebted to Deville for that which is now the commonest process, and it is a very beautiful one. The operation is performed in a common crucible. I will make a rough sketch of a crucible in section, so as to give you a clear idea of what it is. Let the diagram be a section across the middle of a common crucible. Well, then, he lines that with charcoal, which is a common process,—what we call brasquing,—thus making an inner lining of charcoal all the way. Then above he puts a little capsule or cupel, made of charcoal, —a little cup-shaped piece of charcoal. He then covers the whole with a charcoal top, and afterwards places on the cover, and lutes it well down.



Now, that is the apparatus employed in this particular process. In the lower part of the crucible he puts fluoride of aluminium. In the upper part he puts fused boracic acid. He exposes the whole to a high temperature, and the two bodies vaporise. The two vapours come into contact, and they actually decompose each other; and what is the result? Why, off goes the fluorine away from the aluminium, and combines with the boron contained in the boracic acid, and then escapes as fluoride of boron, and the oxygen of the boracic acid unites with the aluminium, and forms the beautifully crystallised substance corundum. Here, then, we can make sapphire in this way most beautifully. At present our artificers have not directed much attention to it, but there is no reason why, if we carried out this branch of investigation, many of our gems might not be produced in this way.

These crystals are generally rhombohedral, terminated by the faces of the regular hexagonal prism; and, according to Deville, they possess all the optical and crystallographical properties of natural corundum. Well, then, by just varying this process, we get the true oriental ruby—not the less valuable kind called spinel, but the true characteristic ruby—simply by adding a little fluoride of chromium. The process must be conducted in an alumina crucible,—the boracic acid must be placed in a platinum cupel. Sapphire is produced in exactly the same manner, and the same colouring agent, namely, fluoride of chromium, is made use of. The reason of this is very obscure. Side by side you may get some of the crystals coloured blue, and some coloured red. The difference is possibly due to a difference in the oxidation of the chromium, but that is a point not as yet clearly revealed by analysis. It is a very peculiar thing. I have seen the same thing occur in certain experiments with glass. We know nothing by analysis of the colouring matter of the sapphire. Whatever it is, it has escaped detection by analysis. Here, by means of the same colouring agents, and under the same conditions, or apparently under the same conditions, we produce sapphire and ruby. Sometimes we find this corundum passing into sapphire, being blue in one part; and jewellers, in setting such things, try with great skill to make it appear that the colourless corundum is coloured, and they set it in such a way that the whole shall appear blue. By increasing the proportions of the chromium salt, Deville obtains a fine, rich, emerald green—an oriental emerald green corundum. This is simply by increasing the quantity of the chromium. Now, it is very peculiar that we can thus succeed in producing artificially one of the finest minerals, except the diamond. The diamond will come ultimately, I have no doubt.

Now, there is another process contrived by Debray, which appears to answer perfectly well. This consists of calcining phosphate of alumina with three or four times its weight of sulphate of soda or potash. He gets, then, tribasic alkaline phosphate and crystallised alumina.

Alumina may be melted by oxygen and the flame of a spirit lamp into glass-like beads, which are stated to be always more or less crystalline on cooling. Gaudin, especially, is the man who, many years ago, experimented upon this subject. The smallest globules show crystalline faces, and they are said to be so hard that their edges will cut glass. Sapphire, whether natural or artificial, is the hardest mineral known except the diamond. Alumina, when melted in the way I have spoken of, is said to be very liquid. By the addition of a very little chromate of potash during fusion, Gaudin obtained a more or less deeply coloured red product, similar in colour to the natural ruby. It is reported to be more or less crystalline, and to possess extreme hardness. I have some of it here in a bottle. I purchased it in Paris many years ago, and he recommended it as something marvellous for sharpening razors.

Now, how does corundum occur in nature? It is interesting to ascertain this point. It occurs frequently in limestone, forming the so-called stratified granite in Newton, in New Jersey, and in New York. It occurs in layers with marble, in the gneiss of the Isle of Naxos, and also similarly in the Isle of Lemnos, and at Magnesia, in Asia Minor. It is there associated with magnetic iron or crystallised magnetite. It occurs along with diaspore in the dolomite of St. Gothard. It occurs near Ephesus, and also in the Isle of Naxos, in the same way. Here are five specimens of corundum in its opaque common form. In its finely divided state it is known to you as emery, which is nothing more than the common form of the true sapphire. Some of the analyses of this substance give water as an essential constituent, but the sapphire and the ruby are nothing more than crystallised alumina without water. But there are analyses of some two or three specimens of corundum in which we find water given as a constituent. An analysis of corundum from Asia Minor gives 3·7 per cent. of water; and an analysis of corundum from India gives 3·1 per cent. of water. In these cases, probably, they contained diaspore associated with them. There is a difficulty in many of these analyses, and we cannot extract rational formulæ of the results obtained by approximate analysis, because these crystals have the power of enclosing within their mass a very large amount of matter which in no way enters into the chemical composition of the mineral itself. It is there as so much foreign matter entangled in the crystal, and yet the crystal shall have a definite form, and so forth. There is a portion of matter which we must not take cognisance of, but we have no means of separating it mechanically from the mass. It all comes into our results, as we have no way of separating this dirt, as metallurgists call it.

Now for some examples of the so-called aluminates. You are perfectly familiar, I have no doubt, with some of these things. There is a form of ruby which is an aluminate of magnesia. It is coloured a fine rich colour, apparently with chromate of potash; but of course it is not, I think, equal to the oriental ruby. It consists of one equivalent of magnesia and one of alumina. Its formula is—$MgOAl_2O_3$, so that you see that the alumina contains three times as much oxygen as the magnesia. It may be obtained beautifully crystallised, and was so obtained by Ebelmen. It is made simply by heating magnesia and alumina with fused boracic acid, with the addition of a little chromate of potash. The experiment was made in exactly the same way as that with reference to the crystallised alumina prepared in the porcelain furnace at Sevres, near Paris, of which I have spoken to you. Ebelmen obtained in this way distinct crystals of aluminate of magnesia, having a fine ruby red colour. They are exceedingly small, but they are, nevertheless, instructive, small though they be. Here is one of the specimens obtained by Professor Ebelmen. Then, by adding a little cobalt, he obtained crystals of the same form, having the characteristic and beautiful blue colour of the natural mineral.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL SECTION.

October 19, 1863.

Professor WILLIAMSON *in the Chair.*

A LETTER from Captain J. Mitchell, dated Madras, May 13, 1863, was read, of which the following is an extract:—"The view that the universal form of cotton hairs is a flattened fibre consisting of scarcely anything but membrane is by no means novel; for much the same description of the cotton fibre has been given by Quekett, Henfry, and many others. Indeed, that opinion is general. Almost every one you ask will tell you that the cotton fibre is flat and twisted, or perhaps a flat spiral. That this is not the general form of the hairs of good cotton any microscopist may satisfy himself in five minutes. An examination of many varieties of cotton has led me to believe that in those descriptions which find most favour in the English market there is a very large proportion of hairs that are entirely or nearly filled with secondary deposits; and on the contrary, in the low-priced cotton, the flat fibre consists of hardly anything but membrane; in fact, an apparently undernourished cell predominates. The knotty portions, which I believe are considered refuse, consist almost entirely of these flat fibres. I believe that the absence of secondary deposit is an indication of careless culture, or, what is much the same thing, of a poor soil."

November 16, 1863.

J. Sidebotham, *Esq., President of the Section, in the Chair.*

The President exhibited some spurious gold slides, on which he remarked that the first offered for sale were made by rolling gummed sand in gold leaf, some even more roughly, by dabbing gold leaf on sand gummed to the slide; whereas, the practice now appears to be to electro-plate plumbago, the result of which, however, differs from the nugget-like form of real gold by being nicely broken off at what would be the angles. Some very good imitations were made by boiling plumbago in oxalic acid and chloride of gold.

Mr. C. O'Neil stated that very beautiful spires of gold were observable on the surface of auriferous quartz boiled in carbonate of soda, and then submitted to the action of heat for a short time under the muffle.

ACADEMY OF SCIENCES.

December 28, 1863.

The last sitting was occupied with the announcement of the prizes conferred by the Academy for 1863.

The Jecker prize of 5000 francs, founded to encourage the study of organic chemistry, has been bestowed on Dr. Hofmann, for his works relating to the artificial organic alkalies.

Montyon prizes, of 1500 francs, were conferred on M. Guignet for his green colour, and another on M. Bouffee for inventing a mixture of picric acid and M. Guignet's *vert de chrome*, intended to supersede the use of arsenite of copper.

NOTICES OF BOOKS.

The Quarterly Journal of Science. Edited by J. Samuelson and W. Crookes, F.R.S. January, 1864. London: Churchill and Sons.

We can, of course, do little more than call attention to the contents of this Journal. They are of a varied character, and all relate to subjects of interest and importance. The scientific survey which forms the introduction gives an able *resumé* of the present state of our knowledge on all branches of natural science; and the chronicles of science, which will always form a considerable section of each number, will carry it on to the latest discovery before the date of publication. The Journal will, therefore, be indispensable to the scientific readers who wish to keep well up with the march of events.

The published list of contributors shows that almost every man eminent in science is disposed to co-operate in placing the *Journal of Science* at the head of the scientific periodicals of the day.

Manual of the Metalloids. By James Apjohn, M.D., F.R.S., &c., &c., Professor of Chemistry in the University of Dublin. London: Longman and Co. 1864.

This volume forms one of the series of manuals on different branches of science, edited by Messrs. Galbraith and Haughton; perhaps the best series of scientific educational works which has issued from the press. The present work worthily maintains the character of the series; but, as a student's "handbook in chemistry," it has the fault of being at once too long and too short. As a "Manual of the Metalloids" it is excellent, including, as it does, almost everything relating to those bodies which it is important to know. A manual of metals, from the same hand, we hope will soon follow; and the two together will constitute a valuable introduction to the study of chemistry.

The term *metalloid* was applied by Berzelius to all the non-metallic elements, but does not seem always appropriate. Its use, however, is sanctioned by the best authorities, and we shall not quarrel with it, nor stay here to discuss the propriety of applying it to other bodies, such as arsenic. Our author restricts the term to those bodies which have always been considered as non-metallic.

The most noticeable part of this work is the introduction, which gives a most lucid account of the principles of chemical philosophy, and we recommend an earnest study of this part to the student.

An admirable review of Gerhardt's system of notation is included, and with regard to this we find the following remarks, which are important, as coming from one of our most successful teachers of chemistry. "After the review which has been taken of the unitary system, there remains little to be added in the way of commentary. The writer of these pages does not object to the doubling of the equivalents of certain of the simple substances (it was long since done in the case of oxygen by Berzelius and Davy), but feels that, after this step is taken, the elements cannot be concluded to have *all* the same atomic volume, for there are several of them of whose specific gravities we are entirely ignorant; and there are three of them—phosphorus, arsenic, and selenium—whose densities have been well determined, and are known to be inconsistent with such a simple law—[*i.e.*, that the atomic volumes of all the simple substances are equal]. The atomic weights of the substances in question being doubled, the atomic volumes of compound bodies will, generally speaking, be equal; but this is not invariably the case; and, to adopt as a general conclusion a proposition affected by numerous well-established exceptions, would appear to be a course quite at variance with the genius of a purely experimental science. The remaining postulate of the unitary system—that the molecules of the simple bodies are composed of atoms associated in pairs—is certainly of a questionable nature. It is not sustained by direct experimental evidence, and does not conduct to any practical results of such importance as would justify its adoption; for it is but a feeble argument in its support that, if received, the molecular volume of most simple, and the atomic volumes of most compound bodies, would become equal to each other. But even though this and other difficulties could be surmounted, grave doubts may be entertained of the expediency of making Gerhardt's theory the exclusive basis of instruction in chemistry. The existing method seems entitled to preference from its comparative simplicity, and because of its resting exclusively on experimental evidence."

Several other passages both in the introduction and body of the work offer themselves for quotation and comment, but we must content ourselves with recommending the book to the intelligent student as one of the very best to which he can devote his attention.

The Pharmacopœia of the United States of America. Fourth Decennial Revision. By Authority of the National Convention for revising the Pharmacopœia held at Washington A.D. 1860. Philadelphia: Lippincott and Co., 1863.

(*Continued from page* 11.)

Among the *Resinæ*, a class of resinous extracts introduced into this Pharmacopœia, we find Resina podophylli. This is directed to be prepared by simple percolation of the May apple with spirit, evaporating the tincture, and precipitating the resin by means of water. As it will be introduced into the British Pharmacopœia, it is not necessary to say more about it at present. A Resina scam.

monii also finds a place in the American work, and, considering the variable quality of scammony, this preparation is perhaps the most reliable form in which the medicine can be exhibited. It is directed to be prepared from commercial scammony, and not from the root. The scammony is exhausted by successive treatments with boiling alcohol; the mixed tinctures are then concentrated, and the resin precipitated by means of water.

The form given for the preparation of Spiritus etheris nitrosi may be recommended as an improvement on that given by the London College in 1851. Careful directions are given for the preparation of a strong alcoholic solution of hyponitrous ether, which is then rectified with a small proportion of carbonate of potash, and afterwards diluted by the addition of more alcohol. The directions, if carefully followed, will probably give a preparation of pretty uniform strength. It is said to have the sp. gr. ·837, and to contain from 4·3 to 5·0 per cent. of its peculiar ether. It is also directed to be preserved in well-stoppered half-pint bottles, and protected from the light.

Spiritus ammoniæ aromaticus is to be made in the way about to be introduced into our own Pharmacopœia. Carbonate of ammonia is dissolved in water with some liquor ammoniæ, the essential oils are dissolved in alcohol, and the two solutions are mixed together. This of course will give a preparation of definite strength and density.

Some of the syrups are very useful and elegant preparations. Among them we notice a Syrupus rhei aromaticus, which must be a nice form for the administration of the medicine to children.

It is made as follows:—

"Take of rhubarb in moderately fine powder, two troyounces and a-half; cloves, in moderately fine powder; cinnamon, in fine powder, each half a troyounce; nutmeg, in moderately fine powder, one hundred and twenty grains; syrup, six pints; diluted alcohol, a sufficient quantity. Mix the powders, and having moistened the mixture with two fluidounces of diluted alcohol, introduce it into a conical percolator, and pour diluted alcohol until a pint of tincture has passed. Add this to the syrup previously heated, and mix them thoroughly." "Syrup," we should add, is thirty-six troyounces of sugar dissolved in water to make two pints, twelve fluid ounces, or, by weight, fifty-five troyounces.

Syrupus scillæ compositus is no doubt a very useful cough medicine, and may be of some interest to our readers at this period of the year, so we insert the formula in another place. In estimating the dose, they must remember that the American pint consists of sixteen ounces, and consequently each ounce of the syrup will contain one grain of tartar emetic.

Among the *Tinctures* we do not find much to remark upon. Tinctura ferri chloridi is here directed to be prepared by dissolving iron wire in hydrochloric acid, the solution being peroxidised by means of nitric acid; the spirit is afterwards added to the cold liquid.

A novelty to us is a Tinctura opii deodorata. In this preparation a fluid extract of opium is first made, and this is treated with ether. The ethereal solution which separates is rejected, and the remaining extract is again dissolved in water, filtered, and then mixed with the alcohol. The advantages of this preparation, if it have any, are unknown to us.

Among the *Trochisci*, we find a recipe for Trochisci cubebæ, which is no doubt a useful and not disagreeable form of dragée. We shall quote the formula elsewhere.

The ointments and wines offer nothing for notice. The list of preparations concludes with those of zinc, and among them we find directions given for making acetate of zinc, by keeping a solution of acetate of lead in contact with metallic zinc, which, we may state, is by no means a satisfactory way of making a pure salt of zinc.

The last feature of the work we shall call attention to is the carefully compiled index, in which the "names are so marked for the quantity of the syllables, that it may serve as a pronouncing vocabulary of the Materia Medica." Here the young pharmaceutist may see how to pronounce "Crē′ta" and "Ichthy̆ŏcol′la;" and the older one who meets with the word for the first time need be in no difficulty about the pronunciation of "Cim′ĭçif′ŭga."

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

2855. Lauchlan Mackirdy, Greenock, Renfrewshire, "Improvements in saturating, washing, and cleansing charcoal and other matters, applicable also to the separation of syrups from sugar."

2875. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of salt, and in boilers to be fed by salt water."—A communication from Charles Louis Edouard Lequin, Nancy, France.—Petitions recorded November 16, 1863.

2383. John Bailey, Salford, George William Blake, Manchester, and William Henry Bailey, Salford, Lancashire, "Improvements in barometers, gas regulators, and other apparatuses for regulating and indicating the flow and pressure of liquids and fluids." Petition recorded September 28, 1863.

2812. Andrew Craig, Rock Ferry, Birkenhead, Cheshire, "Improvements in distilling hydrocarbons from coal, shale, and other bituminous substances, and in apparatus employed for that purpose."

2839. James Medway and Samuel Joyce, Owen's Row, London, "Improvements in the manufacture of starches by the introduction of colouring-matters."

2852. William Edward Newton, Chancery Lane, London, "Improvements in the treatment or manufacture of wrought and cast iron and steel." A communication from Marc Antoine Augustin Gaudin, Rue St. Sebastien, Paris.

2864. Charles Pengelly, Bodmin, Cornwall, "Improvements in mechanism or apparatus for reducing or pulverising ores and other substances required to be reduced or pulverised."

2866. Gilbert Thonger, Birmingham, "Improved modes of preventing accidents arising from the sale or use of poisons."

2886. William Mattieu Williams, Oak Alyn, near Wrexham, Denbighshire, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons, or for the manufacture of the said hydrocarbons and coke."

2888. William Wigfall and Gottlieb Jolly, Sheffield, "An improved explosive compound to be used in the manufacture of cartridges, and an improved mode of manufacturing cartridges therewith."

2894. Heinrich Hirzel, Terminus Hotel, London Bridge, Southwark, Surrey, "Improvements in the manufacture of colouring-matters suitable for dyeing and printing." Petitions recorded November 18, 1863.

2739. Richard Smith, Glasgow, Lanarkshire, N.B., "Improvements in preparing or obtaining colouring matters."—Petition recorded November 5, 1863.

2903. John Kirkham, Euston Road, London, "Improvements in the treatment of certain ores of iron."

2912. George Rait, Canal Bridge, Kingsland Road, and John Winsborrow, Castle Terrace, Pownal Road, Dalston, Middlesex, "Improvements in the construction of dry gas meters, and in the means or apparatus employed therein."

2931. Ferrar Fenton, Camberwell, Surrey, "Improvements in the treatment of vegetable fibres for the production of paper pulp or half stuff therefrom."

2951. Davis Wilson Rea, Upper Thames Street, London, "Improvements in preserving animal and vegetable substances."

Notices to Proceed.

1908. Richard Edwin Bibby, Manchester, "An improved fire-proof cement, which may be employed for covering walls, ceilings, and floors, and is also applicable in the manufacture of fire-bricks, crucibles, retorts, melting pots, and for other purposes where fire-resisting properties are required."—Petition recorded August 1, 1863.

1821. Carl Heinrich Roeckner, Richmond Terrace, Clapham Road, Surrey, "Improvements in machinery and process for reducing wood to a fibrous condition for the manufacture of paper stuff or pulp."

2093. Louis Guillemot, Rue du Moulin à Vent à Poitiers, Vienne, France, "An improved machine for obtaining perpetual motion."—Petition recorded August 24, 1863.

2172. Frederick Charles Phillip Hoffman, Newgate Street, London, "Improvements in machines for crushing hard substances, for washing ores and minerals, and for separating earth and earthy matters from solid substances."—Petition recorded September 2, 1863.

2746. Henry Bessemer, Queen Street Place, New Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in the apparatus employed in such manufacture."

2758. Joseph Townsend, Glasgow, Lanarkshire, "Improvements in the manufacture of nitrate of potash."—Petition recorded November 6, 1863.

2781. Hippolyte Mege, Rue de la Fidélité, Paris, "Certain improvements in the manufacture of soap."—Petition recorded November 9, 1863.

CORRESPONDENCE.

On Scientific Contributions.

To the Editor of the Chemical News.

Sir,—In your impression of Saturday last I perceive a letter from Mr. Draper, apologising to Mr. Spiller for an apparent appropriation of his ideas relative to the Metallic Citrates, which is very creditable to him. I could have wished that a similar act of courtesy had been extended to me in reference to my papers on Nitrates, as neither in the Chemical News nor the *Transactions of the Chemical Society* have I seen any notice, notwithstanding I wrote a letter about it to the President. I had thought, from the extensive circulation of the Chemical News, that one could hardly have failed being acquainted with the prior publication of my paper, particularly as it was of such recent date as to be fresh on the memory; and that, if Dr. Sprengel was really not aware of it, some other member of the Chemical Society would have reminded him of the similarity of our papers; or else what good, or what encouragement, is there in the publication of the results of one's labours, if they are neither read nor acknowledged?

I am, &c. John Horsley, F.C.S.

MISCELLANEOUS.

Thallium.—The following *canard* has been extensively circulated during the past week; it originated with the *Mining Journal*, and speaks more for our contemporary's inventive faculty than for his scientific knowledge:—"It is reported, upon good authority, that a distinguished German chemist has just made an important discovery in connexion with the alloy now generally designated thallium. It appears that, amongst the most ancient records of the ancient Mexicans, an account is given of the mode of preparing the alloy used for producing the brilliant green fire which was freely burnt during the sacrificial ceremonies in honour of Vitzliputzli, one of their principal deities, and that in the attempt to prepare a similar alloy, from the details given, a discovery, opening up an entirely new field of chemical science, has been made. By the peculiar treatment of certain proportions of silver, lead, and selenium, a black powder was produced, so much resembling that designated thallium by Mr. Crookes, that the experimenter was induced to test it. The weight of alloy was precisely equal to that of the metals used, yet the whole of the reactions of thallium were obtained, and salts, bases, and acids of the alloy were produced, precisely as if the alloy had been a perfect metal. Even in the spectroscope the well-known green line was produced. The fact of selenium entering so largely into the alloy is considered to account for Mr. Crookes supposing the so-called thallium to belong to the sulphur group, until M. Lamy showed him the alloy in its metallic state, and proved it to be nearer to silver and lead. Whether the whole of the powders hitherto considered to be pure metals in the pulverulent state are simply alloys has yet to be ascertained. It will be an interesting subject for research, whether chemistry or electricity give an alloy these peculiar qualities. It is anticipated that some tons of thallium will be ready for sale in England at less than the price of silver in the course of a few weeks."

Syrupus Scillæ Compositus, Compound Syrup of Squill—Take of squill in moderately coarse powder, seneka in moderately fine powder, each four troyounces; tartrate of antimony and potassa, forty-eight grains; sugar, in course powder, forty-two troyounces; diluted alcohol water, each, a sufficient quantity. Mix the squill and seneka, and, having moistened the mixture with half a pint of diluted alcohol, allow it to stand for an hour. Then transfer it to a conical percolator, and pour diluted alcohol upon it until three pints of tincture have passed. Boil this for a few minutes, evaporate it by means of a water-bath to a pint, add six fluidounces of boiling water, and filter. Dissolve the sugar in the filtered liquid, and, having heated the solution to the boiling point, strain it while hot. Then dissolve the tartrate of antimony and potassa in the solution while still hot, and add sufficient boiling water, through the strainer, to make it measure three pints. Lastly, mix the whole thoroughly together.

Trochisci Cubebæ.—Take of oleoresin of cubeb a fluidounce; oil of sassafras, a fluid drachm; liquorice, in fine powder; gum arabic, in fine powder; sugar, in fine powder, each three troyounces; syrup of tolu, a sufficient quantity. Rub the powders together until they are thoroughly mixed; then add the oleoresin and oil, and incorporate them with the mixture. Lastly, with syrup of tolu form a mass, to be divided into troches, each weighing ten grains.—*American Pharmacopœia.*

Spiritus Ammoniæ Aromat.—In consequence of an accident a number of typographical errors occurred in the article with the above heading, published last week. The reader is, therefore, requested to make the following corrections:—Page 5, omit the line *Spt. Amm. Aromat.*; in the following line, for *are* read *is*. Page 6, col. 2, fifth line, for *primary* read *passing*; line 8, for *experiments* read *experiment*.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

J. J.—The paper will appear in our next number.

Reader.—A different treatment is required in most cases. Give us a definite example, and we will give you the information.

A Subscriber.—Sulphide of carbon is a good solvent.

J. D.—See sundry papers in Vol. VI. Chemical News.

Received.—M. B., W. B., H. H., next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Separation of Stannic and Tungstic Acids, by C. Rammelsberg.*

According to H. Rose,† these acids may be separated by heating them in a stream of hydrogen. When the reduction is attempted in a porcelain crucible, a loss is always experienced, arising from the oxygen of the stannic acid, which is reduced to metal, and a third of the oxygen of the tungstic acid, which changes to tungstic oxide. By boiling in hydrochloric acid, the tin is dissolved, and can be precipitated by sulphuretted hydrogen, while the tungstic oxide is reconverted into tungstic acid by ignition in the air.

After analysing the compound of stannic and tungstic acid with iron and manganous oxide, described in the memoir mentioned below, I was induced to investigate this method, and first of all employed weighed quantities of the two acids.

I. 1·065 of pure stannic acid and 2·375 of pure tungstic acid lost, after the first half hour's ignition (at about a temperature at which, under equal conditions, tinstone would be reduced), 0·43. At a stronger heat, 0·115 more; together, 0·445. And by a still longer continuation of the process, 0·085; total, 0·63.

100 parts of the mixture employed contained—

		Oxygen.	
Stannic acid .	30·96	6·625	6·625
Tungstic acid .	69·04	14·291⅓ =	4·764
	100·00	20·916	11·389

If, therefore, the stannic acid was reduced to metal, and the tungstic acid to oxide, the loss should amount to 11·39. Instead of this, however, the loss after the first heating amounted to 12·50 per cent.; after the second, 15·84 per cent.; after the third, 18·31 per cent. Thus, at the commencement, a portion of metallic tungsten was produced, the proportion of which naturally increased afterwards.

The residue ought to have given with hydrochloric acid only a colourless solution of chloride of zinc; but, instead of this, it gave first a blue and then a brown solution, while a part remained undissolved, which, by heating in the air, formed tungstic acid. The brown solution was filtered, but, after dilution, it became decolorised, and deposited yellow tungstic acid.

It appears, therefore, that it is difficult to conduct the operation so as to ensure the reduction of the tungstic acid only as far as the oxide WO_2, and quite as difficult to separate the same from metallic tin by hydrochloric acid.

II. To ascertain whether the strong heat of a gas lamp would also effect a complete reduction of tungstic acid, 1·222 of stannic acid and 1·803 of tungstic acid were strongly ignited in hydrogen gas. The loss of weight after the first ignition was 0·491; after the second, 0·631; and after the third, 0·645.

100 parts of the mixture contained—

		Oxygen.
Stannic acid . . .	40·4	8·645
Tungstic acid . . .	59·6	12·337
	100·0	20·982

The loss of weight in the above experiment, expressed in percentages, were as follows:—After first heating, 16·23; after the second, 20·86; after the third, 21·32. The last number is somewhat higher than the calculation requires, probably in consequence of the volatilisation of some of the tin. In this case the reduction was complete. The grey pulverulent mass contained white, malleable granules of tin, gave a colourless solution with hydrochloric acid, and left a black residue, which, ignited in the air, gave 0·778 of yellow tungstic acid, answering to 58·78 per cent. (Loss 0·82 per cent.)

III. 2·212 of stannic acid and 2·116 of tungstic acid lost, after several hours' strong ignition, 0·88 = 20·33 per cent.

The mixture contained—

		Oxygen.
Stannic acid . . .	51·11	10·937
Tungstic acid . . .	48·89	10·120
	100·00	21·057

In this instance, therefore, the reduction was almost complete.

Rose's method may also be employed under the supposition that the tungstic acid is reduced to metal. This point, however, cannot be ascertained by a constant weight of the residue, inasmuch as, in consequence of the volatilisation of the tin, the weight continues to diminish. For the same reason the direct estimation of the tin by this method is impossible.

Rose, who has shown‡ that stannic acid, when ignited with sal-ammoniac, is completely volatilised, states also that under the same circumstances tungstic acid remains unchanged, but that, in the presence of alkalies, tungstic oxide, tungstenamid, and nitride of tungsten are formed. I have employed chloride of ammonium as a means of separating quantitatively the two pure acids, and have obtained satisfactory results.

As the conversion of stannic acid into volatile chloride of tin requires a long time, the treatment of the mixture with six or eight times its weight of sal-ammoniac must be repeated several times, until no further loss of weight is observed. Great care must be taken that the outside of the porcelain crucible and cover does not become overspread with stannic acid, which is formed afresh from the chloride and surrounding moisture. Hence the smaller crucible should be placed in a larger one similarly covered, and heated to tolerably high temperature. The residue of tungstic acid is soon coloured green, then blackish; when heated in the air it becomes yellow, and has a constant weight.

I. 0·6977 stannic acid and 0·7335 of tungstic acid gave a final residue of 0·7225, which, after ignition in the air, weighed 0.7255. The difference amounts to 0·008; that is, instead of 51·26 per cent., only 50·7 per cent. was obtained.

II. 0·554 stannic acid and 1·332 tungstic acid left behind 1·337 of the latter; that is, instead of 70·62 per cent., I recovered 70·89 per cent.

I have employed this method for the separation of the two acids in the combination mentioned at the commencement of this paper.

On Solution, by Barnard S. Proctor, *Esq.*

While experimenting in August, 1860, I had occasion to mix 4 drachms of commercial carbonate of potass (not bicarbonate) with 7 fluid drachms of strong liquor of ammonia, ·880 sp. gr. I was surprised to find so deliquescent a salt settle to the bottom with little appearance of solution. It had simply become moist, and disengaged a little gaseous ammonia.

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* *Annalen der Physik und Chemie,* Bd. cxx., 66.

† "Traité Complet de Chimie Analytic. Analyse Quantitative." Paris, 1861. P. 486. *Dexter Ann. der Physik und Chemie,* Bd. xcii., s. 335.

‡ *Op. cit.,* vol. i., p. 234.

After thirty hours' contact, a small portion of oily-looking solution floated between the carb. potassa and the liquor of ammonia. A little of the ammoniacal liquor on evaporation left a small fixed residue. Seven drachms of rectified spirit of wine were then added to the former mixture, and were found to expedite the solution of the carbonate of potass, the whole being dissolved in the course of an hour, forming a heavy solution not miscible with the ammoniacal liquor.

It was conjectured that the presence of the spirit might prevent the intersolubility of the two solutions; and to ascertain whether or not this was the case, two measures of a saturated aqueous solution of carbonate of potass, and one measure of strong liquor of ammonia, were agitated together. As complete separation appeared to take place, the proportions were reversed—that is, two parts of the ammoniacal to one of the potass solution—but with the same result. The proportion of the ammonia was gradually increased till it amounted to about thirty times the measure of the potass solution, at which point the potass liquor dissolved in the ammoniacal.

I then thought it interesting to know to what extent the ammoniacal liquor would dissolve in the carbonate of potass solution, for which purpose 180 minims of the latter solution were taken and 10 minims of liquor of ammonia added, which readily dissolved. Further additions were then made, 10 minims at a time, at every fifth addition the solutions being allowed to stand for five minutes.

In this manner, 140 minims were added before permanent turbidness was produced, the last four additions having produced milkiness and partial separation at the point of contact of the two solutions, until they were shaken, when perfect solution was effected. A further addition of 10 minims gave a permanent turbidness, resulting in a separation of the fluid into two solutions, the bulk of the heavier being to that of the lighter as 210 to 110—that is, the potass solution had gained 30 minims and the ammoniacal liquor had lost 40, the separation of the two being as distinct as the separation of oil from water. On standing twenty-four hours, re-solution appeared to be taking place, the line of contact being much less visible, and appearing like that of two intersoluble liquids, as proved to be the case, perfect solution taking place on agitating them. During the twenty-four hours, a small, heavy, crystalline precipitate had deposited, probably carbonate of potass.

More ammonia was then added in the same manner as before, to the extent of 70 minims, before separation again took place, the bulk of the heavy liquid now being 115 and the light being 275—that is, the potass solution had lost 65 minims and the ammonia gained a similar bulk. On re-agitating and settling, the potass solution increased in bulk again, and, in the course of twelve hours, re-solution of the two liquors was again taking place.

With the desire of making the separation of the two solutions more visible, I purposed colouring the ammonia with sulphate of copper; but here again I met with unexpected results, for the immersion of a crystal of the sulphate scarcely tinted the ammonia; the crystal itself becoming coated with a dark blue crust.

A small quantity of a saturated solution of sulphate of copper was then added to the ammonia; a blue precipitate was produced, which was, contrary to expectation, almost insoluble in the excess of ammonia present.

A small crystal of nitrate of copper was found to dissolve freely in the ammonia, affording the deep blue liquor which was desired, and with this solution I hoped to render more conspicuous the separation of the potass from the ammonia; but again my experiment proved less successful, though not less interesting, than I anticipated, for on the separation taking place the potass liquor was found deep blue, and the ammonia almost colourless.

Though the results I have indicated with solutions of carbonate of potass and ammonia are very remarkable, they are not so completely isolated as I at first thought.

That two aqueous solutions should not be soluble in one another, or readily miscible in all proportions, is a fact which would be thought striking by most chemists at first sight; but, on closer attention, we find several well-known phenomena of a somewhat similar nature.

The solubility of ether and water, which I before noticed, is a case in point: both the heavier and the lighter portions may be regarded as aqueous solutions. Again, the familiar case of carbonate of potass being added to weak spirit, a dense aqueous solution is formed at the bottom, and the supernatent liquid may be regarded as an aqueous solution of alcohol.

I also find that a saturated solution of oxalate of potass is not a solvent of a saturated solution of potass soap; and this leads us to the fact made use of in the soap works, that a concentrated solution of caustic soda is not a solvent of curd soap; so we find links in the chain sufficient to connect these new observations with other chemical facts well known and usefully applied.

I have sought to multiply instances of this species of insolubility with the hope of deducing a law, but I have as yet only met with one other salt—the soluble silicate of soda—which is not intersoluble with the aqueous ammonia.

I thought to find some solution which would compare with ammonia in its action, but as yet have found none, unless, as I just now suggested, we look upon ordinary spirit as a solution of alcohol. I have found four other salts, whose saturated solutions settle in spirit, like the carbonate of potass, without mixing, namely, phosphate of potass, citrate of potass, citrate of ammonia, and silicate of soda. Besides these, solutions of various other salts, which are less deliquescent, settle in the spirit, more or less speedily give up their water, while the salt itself is deposited in crystals. In this respect, also, the spirit and the ammonia resemble each other. Of eleven solutions of very soluble salts which are caused to crystallise by being poured into spirit, four crystallised on being poured into ammonia, namely, carbonate of soda, sulphate of soda, Rochelle salt, and chromate of potash.

The most interesting case of crystallisation which I have observed is that of carbonate of soda. Spirit abstracts the water from a cold saturated solution of carbonate of soda, causing immediate crystallisation, but a hot saturated solution settles in the spirit, without mixing or undergoing crystallisation; and even after cooling and standing for several hours the solution remained fluid and separate from the spirit, until, a small crystal having been dropped in, rapid crystallisation took place, the water of the solution then, of course, uniting with the spirit.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by George F. Rodwell, *F.C.S.*

(Continued from page 16.)

Some of the more important of the forty-three experiments detailed in the treatise we are considering, are given below:—

In the first experiment Boyle explains by what means the receiver of his air-pump is exhausted, and he affirms that most of the experiments which he is about to relate, may be explained by bearing in mind the fact, "that there is a spring or elastical power in the air we live in."

He compares the air to a fleece of wool, or a dry sponge,[*] or says we may admit Des Cartes' theory, that the air is made up of innumerable flexible particles, which are so moved about by the motion of the celestial matter in which they swim, that each particle keeps those around it at a distance. Boyle prefers to believe that the air itself is elastic, rather than to admit Des Cartes' theory.

The height of the atmosphere, according to Kepler, is only eight miles, but Ricciolo makes it probable that it extends to a height of fifty miles. Can we not, therefore, well imagine, writes Boyle, that the weight of a column of air of such a height will keep "the little springs" of the air bent, and that when that weight is removed they will straighten themselves.

Experiment 2. When a stoppered receiver was exhausted of air, great force was found to be necessary to remove the stopper.

From the length at which this experiment is detailed it would appear that Boyle had not heard of the Magdeburgh hemispheres, although they were invented several years previously.

Experiment 4. A half-blown bladder placed in the receiver became fully expanded on exhausting.

This experiment had been previously tried by Roberval, by introducing a nearly empty carp's bladder into the Torricellian vacuum.

Experiment 5. When the exhaustion was long continued the bladder burst; a partially-filled bladder also burst when held near a fire.

Experiment 6. In order to determine to what extent a known quantity of air could be made to expand, when pressure was removed from it, Boyle took a phial containing four or five drachms, tied an empty lamb's bladder over its mouth, and placed it in the air-pump receiver; exhaustion was continued until the bladder was fully expanded, and by comparing the capacities of the phial and bladder, the air was found to have expanded to nine times its original bulk.

This mode of experimenting was evidently borrowed from Bacon, who, in the 40th Aph. of Book 2 of the "Novum Organum," describes an experiment which he made in order to determine the space occupied by the vapour produced from a liquid occupying a known space; in other words, the ratio between the spaces occupied by a substance when in the liquid and gaseous states. This experiment, although it could only give most fallacious results, is well worthy of record, inasmuch as it was made at a time when experiments of any kind were rare, and quantitative experiments most rare.

Bacon filled an ounce phial, of known weight, with the lightest liquid with which he was acquainted (spirits of wine), weighed, to determine the amount of spirit taken, and tied an empty bladder, containing about two pints when full, over the mouth of the phial; the spirit was heated until the bladder was fully expanded, when the heating was discontinued, the bladder pricked to allow the vapour to escape, and then removed from the phial; on reweighing the phial, the amount of spirit converted into vapour was found, and the space it occupied being compared with the contents of the bladder, it was shown that the spirit of wine occupied in the state of vapour 100 times the bulk it possessed in the liquid form.

But we must return to Boyle's experiment on the expansion of air under diminished pressure. After making the experiment with the bladder and phial, he devised a far more accurate method, which was to place within the receiver a tube, closed at one end, to which a divided scale was attached, and the capacity of which was known. The tube was entirely filled with water, with the exception of the space occupied by a small quantity of air of known bulk, and its lower end was placed in a vessel of water. When pressure was removed, the air within the tube expanded and depressed the column of water, and the amount of expansion was shown by the scale. By this means it was found that air expanded to thirty-one times its bulk, but the tube was too short, and the air still continued to expand, when the experiment had to be stopped. He next made use of a tube three feet long, passed it air-tight through the cover of the receiver, and placed the phial of water, into which its open orifice dipped, within the receiver; a known quantity of air was now found to expand to 152 times its previous bulk; it is obvious, however, that the inaccuracy of the experiment increases with the length of the tube, because, when the exhaustion has proceeded to a certain extent, the column of water will fall, not only on account of the expansion of the air above it, but also because its own weight can partially overcome the pressure of the rarefied air in the receiver.

Experiment 7. A small globe of very thin glass, filled with air, was placed in air-tight connexion with an exhausted receiver: on suddenly turning the stop-cock so as to open free communication with the receiver, the globe was not broken, probably, Boyle says, on account of its shape.

Experiment 8. The helmet of a glass alembic was fitted with a stop-cock, every other part being closed; the shank of the stop-cock was cemented into the upper orifice of the pump-barrel; on exhausting, the helmet was broken.

Experiment 9. A glass tube, open at both ends, was cemented firmly into the neck of a glass phial containing a small quantity of water, so that its lower end reached nearly to the bottom of the phial; the latter was placed in a small receiver, and the tube passed air-tight through the cover; on exhausting, the phial was burst,[†] because, says Boyle, the inside of the phial had to bear the whole weight of the atmosphere, and there was no corresponding pressure to counterbalance it on the outside. The thinnest glass vessel is not broken in the air, because both the inside and outside are equally pressed; in other words, it is submitted to no pressure at all.

Experiment 10. A lighted candle was placed in the

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[*] Hero of Alexandria, who was acquainted with the elasticity of the air, compares it to horn shavings, or a sponge. See the first of these papers, Chemical News, vol. viii., p. 115.

Pascal, as we have seen in the previous paper, compared the air to wool, a favourite simile of Boyle's throughout this work, but whether taken from Pascal or not it is difficult to say. Pascal's treatise "On the Weight of the Mass of Air," was not published till 1663, but Boyle may have heard of the comparison from some one who had conversed with Pascal.

[†] The phial burst with such violence that it cracked the air-pump receiver,—a not unfrequent occurrence, however, from other causes; and, as receivers were difficult to procure, Boyle was in the habit of covering the cracks with cement, and afterwards with diachylon plaster. The following is his account of the preparation of the cement:—"The plaister was made of good quicklime, finely poudred, and nimbly ground with a pestle in a mortar, with a quantity (I know not how much precisely, not having the essays in this place) of scrapings of cheese, and a little fair water, no more than is just necessary to bring the mixture to a somewhat soft paste, which, when the ingredients are exquisitely incorporated, will have a strong and stincking smell. Then it must be immediately spread upon a linnen cloath of three or four fingers' breadth, and presently apply'd, lest it begin to harden. But if your Lordship had seen how we mended with it receivers, even for the most subtle Chymicall spirits, you would scarce wonder at the service it hath done in our Pneumaticall Glass."

receiver; on exhausting it was extinguished. When burnt in the closed receiver, without exhausting, it continued alight for a much longer time.

Experiment 11. A wire basket, filled with ignited charcoal, was suspended in the receiver; on exhausting the charcoal ceased to glow sooner than when the receiver was not exhausted; but a piece of red-hot iron did not appear to lose its redness sooner in a vacuum than when placed in the closed receiver.

Experiment 12. A piece of lighted match, "such as souldiers use," was placed in the receiver; it was quickly extinguished, and an immense quantity of smoke was produced.

Experiment 13. In order to see whether the match was extinguished for want of air, or because the smoke pressed upon it, and stifled the flame, a partially-blown bladder was introduced with the match, to see if the fumes exerted appreciable pressure, but the bladder expanded quite as readily as when it was placed in the receiver without the match.

Experiment 14. Gunpowder could be fired in an exhausted receiver, and a flint and steel meeting together in collision produced sparks.

(To be continued.)

TECHNICAL CHEMISTRY.

A Few Words on the So-called "Sombrero Guano," and some other Natural Phosphates, by Dr. PHIPSON, *F.C.S., &c.*

IN the last number of the CHEMICAL NEWS appeared an article (taken from the *American Journal of Science*, xxxvi.) on the so-called "Sombrero guano," in which the writer, Mr. Alexis Julien, endeavours, in a blundering manner, to criticise my opinion upon the nature of the mineral Sombrerite,[*] the essential part of this "Sombrero guano." It would appear that this gentleman, who styles himself "resident chemist at Sombrero," and assigns to bone phosphate the composition $3CaO,PhO_5$, whilst pretending that $2CaO,PhO_5$ can be washed off a filter with hot water, and that chloride of sodium is deliquescent, has not been able to ascertain the true composition of the rock on which he resides, and regrets that "Dr. Phipson does not inform us of the method used by him in his analysis." According to the "resident chemist," one-half of the cargoes exported from Sombrero contain 83 to 85 per cent. of bone phosphate of lime! We might add that the other half may then be supposed to consist of coral rock or carbonate of lime.

In making my analysis of Sombrero rock, I had merely in view the elucidation of its true composition. I was not prepossessed in favour of any "cargoes." The first sample I analysed was taken by myself from a bulk of some seventy tons, and the second from another bulk of about thirty tons. Since then several other samples have been forwarded to me for analysis. They all give very similar results, save when mixed with an undue proportion of carbonate of lime; and 65 per cent. of tribasic phosphate of lime, 17 per cent. of phosphate of alumina, with 4 to 5 per cent. of carbonate of lime, as in my published analysis, may be fairly taken as the average composition of the pure Sombrero phosphate.

I have designated this amorphous rock Sombrerite,[†] as it is the only natural example we have of a compound of phosphate of lime with phosphate of alumina.

The similarity of appearance between the madreporic rock (carbonate of lime) and the Sombrero phosphate does not allow them to be easily distinguished by persons unaccustomed to observe. Hence, it is not surprising that a considerable amount of this coral rock reaches England along with the phosphate. Its presence is, however, easily detected in the commercial world by a drop of muriatic acid, which causes immediate effervescence; and the few persons who purchase this rock phosphate here in London (paying for it about the same price as for the best description of bone ash) are well aware of this impurity. We cannot but suppose that the "resident chemist" is also aware of this admixture, and the effects it has upon the composition of "a well-chosen specimen," especially when such a mixture is imperfectly analysed, and the composition of bone phosphate written $3CaO,PhO_5$. At such a rate, we may, indeed, inform the public that Sombrero phosphate contains 83 to 85 per cent. of bone phosphate of lime, but with the risk of being exposed!

The late Mr. John Nesbit analysed four specimens of this Sombrero rock as early as 1858 (but did not recognise its atomic composition); these four specimens gave from 9 to 13 per cent. of oxides of iron and alumina; my analysis alluded to above shows 17 per cent. of phosphate of alumina, and yet Mr. Alexis Julien boldly asserts that this Sombrero phosphate contains "less than 1 per cent. of phosphate of alumina, and often none!"

The resident chemist at Sombrero regrets that I do not make known my method of analysis; I will state at once that it is to be found entire in the treatise of Fresenius, and recommend it to his particular attention.

As to the origin of Sombrero phosphate, it is evidently in no way connected with guano. I have shown elsewhere[‡] that not a trace of uric acid can be discovered in it, nor do we find any compound of alumina in the ash of guano. Guano appears to split up naturally into two parts by gradual decomposition, the one consisting of bicarbonate of ammonia, which, according to my analysis of a specimen from the Chinca Isles, contains NH_4O, 29·76; CaO, 6·02; HO, 11·00; CO_2, 51·53; uric acid and alcalis, 1·09; phosphoric acid, 0·60, &c., = 100·; and the other, known as "West India phosphate," which gave me—Phosphate of lime, 35·5; carbonate of lime, 34·0; with 16·5 per cent. of organic matter, containing 0·46 of nitrogen, and in which I recognised a notable amount of the true Xanthic oxide, precipitable from its solution in soda by a current of carbonic acid.

As I am upon the subject of natural phosphates, I will state here that, besides the Cambridge and Suffolk coprolites so plentiful in England, the former of which, according to a great number of analyses made in my laboratory, contain on an average 65 per cent. of tribasic phosphate of lime, and the latter 56 per cent. of this phosphate, there exists also in the chalk districts of England, particularly those of the Isle of Wight, fossil wood and other petrified remains of sponges, polypes, &c., which contain a large amount of phosphates.[§] The following is the analysis of a specimen of fossil wood of this description, forwarded to my laboratory about eighteen months ago. Its specific gravity was 2·71, its colour brown; it lay in the green sand of the Isle of

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[*] *Journ. of Chem. Soc.*, 1862, and CHEMICAL NEWS, vol. vi.

[†] *Loc. cit.*

[‡] *Journ. of Chem. Soc.*, 1862, p. 277, and 1863, "On the Bicarb. of Ammonia of the Chinca Isles."

[§] I believe Mr. Thomas Way was the first to call attention to them in 1848.

Wight, and showed here and there on the surface minute crystallisations of wavelite. It gave me in 100 parts—

Water	11·00
Organic matter	6·62
Lime	38·52
Magnesia	1·00
Oxides of iron and uranium	2·13
Phosphoric acid	32·43
Fluorine	3·90
Chlorine Sulphuric acid }	traces.
Sand, &c.	4·40
	100·00

The quantity of phosphoric acid in this fossil is nearly equivalent to 70 per cent. of tribasic phosphate of lime, and I am informed that considerable quantities of such fossils are to be found in the south of England. This composition approaches that of the Estramadura phosphate, or apatite, imported from Spain, the pure samples of which contain—

Tribasic phosphate of lime	92·00
Fluoride of calcium	8·00
	100·00

It results from the foregoing—

1st. That the so-called "Sombrero guano" is not a guano at all, nor has any relation to guano. That it is a distinct compound of phosphate of lime and phosphate of alumina, to which I have given the name of Sombrerite. That this Sombrerite forms the essential part of the Sombrero phosphate, and that this rock is frequently mixed accidentally or intentionally with a large amount of carbonate of lime.

2nd. That the richest of all mineral phosphates in phosphate of lime is the Estramadura phosphate from Spain, and that we have phosphates in England in abundance, the composition of some of which approaches that of the latter.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, January 6, 1864.

G. W. Sandford, *Esq., President, in the Chair.*

The first paper read was "*On the Importation of the Root-Bark of Chinchona Calisaya from Bolivia,*" by John Eliot Howard, F.L.S. The author stated, that in recent importations of calisaya bark from Bolivia he had noticed the admixture, to a large extent, of the root bark, a specimen of which was before the meeting, and which presented sufficiently striking characteristics to distinguish it from the ordinary calisaya bark. Its curly form was its chief peculiarity. The probability of the root-bark finding its way into use in the manufacture of tinctures and decoctions, had induced him to examine it. The yield of a very favourable specimen of root-bark in purified alkaloids was 8·14 parts in 1000. Of this only 3·06 parts were obtained as a crystallised salt of quinine, the rest consisting almost entirely of the quinidine of Pasteur. Further investigation was demanded to account for the substitution of quinidine for quinine in the descent of the sap to the roots of the plant, and, if confirmed, would be somewhat curious. There was no doubt that the first formation of the alkaloids took place in the leaves, and it would be very interesting to know how, in the downward descent of the sap, such changes as the conversion of one alkaloid into another could take place. The collectors in Bolivia had succeeded in selling the root-bark as genuine calisaya, but the low estimation in which it was held in Europe had disappointed them.

Professor Bentley remarked that much importance was attached to Mr. Howard's paper. It showed that the proportion of quinine existing in the root-bark was very much less than that found in the ordinary calisaya bark of commerce. All purchasers of bark should be made aware of this, and be on their guard, so as not to be deceived into purchasing the root-bark for the true calisaya.

Mr. Hanbury said that the observations of Mr. Howard were parallel to those of M. De Vrij on the chinchona cultivation in Java, where he had proposed to extract the alkaloid from the root-bark, but had found the yield very poor.

Professor Redwood said there were other falsifications of calisaya bark even more important than that of the admixture of the root-bark, because they contained no quinine. His own opinion was, that calisaya bark did not contain the amount of quinine which had been ascribed to it. He was in the constant habit of analysing calisaya, but had never found the large proportion of quinine which had been stated to exist.

The next paper was "*On Goa Powder,*" by David S. Kemp, Bombay. The substance known as Goa powder was first introduced into Goa, on the Bombay coast, some twelve years since, by a Portugese merchant. It was in masses, mixed with fragments of root, stems, bark, and other matters. The masses were reduced to powder, and sold at Goa, from whence it found its way to Bombay. The importer afterwards removed to Mozambique, where he died, and it is believed that the manufacture of Goa powder is still carried on at that place. Goa powder is a light, chocolate-coloured powder, and is used very successfully in obstinate skin diseases, to which both Europeans and natives are subject. It is rubbed on the skin with water or lemon juice. From the analogy existing between the substances found in Goa powder by the author in his analyses, with erythroleic acid and azoerythrin—bodies obtained from orchella-weed—and from the fact, that large quantities of the orchella are exported from parts north of Mozambique, it is highly probable that the orchella-weed is a large constituent of Goa powder.

Dr. Attfield, having examined a specimen of Goa powder, furnished him by Mr. Hanbury, with whom the author had communicated, could fully confirm Mr. Kemp's diagnosis. From his examination of Goa powder, he was led to think that English cudbear was a good representative of it. The colorific matters contained in it confirmed this.

After this, a "*Note on the Recovery of Essential Oils from their Watery Solution,*" by T. B. Groves, was read. The author was led to the discovery of the process by the failure of the process of M. Piver, given in the "Reports of the Juries," 1851. The object was the concentration of an aromatic water into a spirituous essence. To the water was added about one-eighth of its volume of olive oil, which was emulsed by solution of potash. The emulsion was destroyed by the addition of an acid, when the olive oil immediately rose to the surface, bringing with it almost all the aroma. The aromatic oil was easily separated from the fatty oil by agitation with rectified spirit.

Thomson's Patent Bottles for the Prevention of Poisoning were exhibited, and the construction of them explained to the meeting. The chief feature consists of the substitution of a metal cap for the ordinary cork or stopper. To the cap is attached a small key, with which it may be locked, thus preventing access to poisons of persons not in possession of a key, and offering a peculiarity sufficiently obvious either to dispenser or patient to remind that the bottle contains a poison.

Mr. Thonger also laid before the meeting some of his *Patent Labels for the Prevention of Accidental Poisoning.* The preventive consists of a border of sand-paper round each label, thus appealing strongly to the sense of touch. It was applicable to dispensing bottles and to the smallest phials, and possessed an advantage over any form of bottle, inasmuch as the label could be applied to any vessel, while the chemist would often be compelled to put poisons into ordinary bottles for want of one of a particular shape being in stock.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

December 29, 1863.

E. W. Binney, *F.R.S.*, *F.G.S.*, *President, in the Chair.*

Mr. Sidebotham exhibited two photographs which he had taken from a book in the possession of Mr. Buxton, of Daresbury, entitled, "Histoire de la Navigation aux Indes Orientales, par les Hollandois," Amsterdam, 1609. One of these represents the title-page, which is interesting as showing, in the map of Africa which it contains, the course of the Nile and the two lakes from which it springs, one of them having two outlets. The other photograph shows, among figures of other productions of the Mauritius, that of the Dodo. It would appear that this is the earliest figure of this now extinct bird.

T. T. Wilkinson, F.R.A.S., communicated the following note on the late meteor:—On December 5, 1863, at about 7h. 55m. p.m., I observed a very brilliant meteor at Haslingden. It passed from the north towards the west, and was first visible to me when near to γ *Ursæ Majoris*. The nucleus was of an egg-like form, the head being intensely bright and considerably broader than the rest. The atmosphere was quite clear at the time, and hence I had a good view of its whole passage. Its colour was pale blue, and the light it emitted was so intense that the public gas lamps were immediately put into shade, and suddenly threw their shadows across the road. The tail of the meteor gradually tapered to a point, and appeared to give out sparks of a purplish tint. When about 4° beneath α *Lyræ*, the meteor exploded, and then the sparks were so variegated in colour—the red and purple tints prevailing—that they gave me the idea of a rocket, and I for a moment thought that the Haslingden people were doing this in honour of the Marquis of Hartington's visit to their town. This illusion was, however, immediately dispelled. The whole time of passage did not occupy more than a few seconds. Although several hundreds of persons witnessed the phenomenon, I cannot find that any one heard any sound made by the meteor either during its passage or on its explosion.

NOTICES OF BOOKS.

The Retrospect of Medicine: being a Half-Yearly Journal, containing a Retrospective View of every Discovery and Practical Improvement in the Medical Sciences. Edited by W. Braithwaite, M.D., &c., &c., and James Braithwaite, M.D. Vol. XLVIII., July to December, 1863. London: Simpkin, Marshall, and Co. 1864.

We can only notice the punctual appearance of this very useful compilation. With nothing of particular importance, it contains the usual amount of well-selected matter.

The Ghost! as Produced in the Spectre Drama; popularly Illustrating the Marvellous Optical Illusions obtained by the Apparatus called the Dircksian Phantasmagoria: being a full Account of its History, Construction, and Various Applications. By Henry Dircks, Civil Engineer, &c., &c., the Inventor. London: Spon and Co. 1863.

The title of the work well explains its contents, and the marvellous ghost need no longer be a mystery to any one who will read this little book. Everything relating to it is fully explained, and excellent suggestions are given for producing new illusions. We are sorry to say that there are, besides, a preface and an appendix, which are painful to read, on account of the personal dispute introduced.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(EIGHTH NOTICE.)

(Continued from Vol. VIII., page 299.)

We resume our notices of this deeply interesting Report, and come next to Phosphorus. This element is found in minute quantities almost everywhere in Nature. It is an essential constituent of fertile soils, and of all living organisms. But people have been rather puzzled to account for the mountains of apatite (crystalline phosphate of lime) which have already been found in one or two parts of Europe, and which may exist in other quarters of the globe. We quote the Reporter's explanation:—"Large masses of phosphorus are, in the course of geological revolutions extending over vast periods of time, restored from the organic reigns of Nature to the mineral kingdom by the slow process of fossilisation, whereby vegetal tissues are gradually transformed into peat, lignite, and coal; and animal tissues are petrified into coprolites, which, in course of time, yield crystalline apatite." And then:—"After lying locked up and motionless in these forms for indefinite periods, phosphorus, by further geological movements, becomes again exposed to its natural solvents, water and carbonic acid, and is thus restored to active service in the organisms of plants and the lower animals, through which it passes, to complete the mighty cycle of its movements, into the blood and tissue of the human frame. While circulating thus, age after age, through the three kingdoms of Nature, phosphorus is never for a moment free. It is throughout retained in combination with oxygen, and with the earthy or alkaline metals, for which its attraction is intense."

Free phosphorus has, however, become a necessity for civilized people, and it is now manufactured in enormous quantities by some modification of the following process devised by Nicolas and Pelletier. The principle of the method is the reduction of monobasic phosphate of lime by carbon. Bone ash (tricalcic phosphate) is treated with sulphuric acid, which abstracts part of the lime:

$$Ca_3PO_4 + H_2SO_4 = CaH_2PO_4 + Ca_2SO_4.$$

The acid solution of monocalcic phosphate is boiled down to a syrup, a small quantity of tricalcic phosphate which separates is removed, and the residue is heated to redness; the basic water of the acid phosphate escapes, and a residue of metaphosphate (monocalcic phosphate) remains. This salt is mixed with charcoal and exposed to a higher temperature, when a quantity of phosphoric acid is reduced to phosphorus as will reproduce tribasic phosphate:

$$3CaOPO_3 + C_5 = Ca_3PO_4 + 5CO + P_2.$$

The operation is generally carried on in the following manner:—

"The fresh bones are first freed from fat by boiling them in water, and skimming off the fat which floats upon the surface.

"The bones, thus freed from fat, are further treated in one or other of the following ways. In some cases the gelatinous matter is extracted by superheated steam, and the remaining earthy matter, after being dried and burnt, is used for the preparation of phosphorus. In other cases the bones are exhausted with dilute hydrochloric acid; the remaining cartilaginous substances used for the preparation of gelatine; and the acid solution of the bones precipitated with milk of lime, or better, with crude carbonate of ammonia. The tricalcic phosphate thus obtained, after being heated to low redness, is ready to be used for the preparation of phosphorus.

"Another process consists in subjecting the bones to destructive distillation, whereby ammonium salts and bone charcoal are obtained. The latter is either first used in the refining of sugar, or the crude bone charcoal is purified by exhausting it with hot hydrochloric acid, and the acid solution transformed as above into tricalcic phosphate."

Other processes have been proposed to obviate the necessity of treating the bones with sulphuric acid. One of these is that patented by M. Cary-Martrand. It is based on the following reaction:—When a mixture of bone phosphate and charcoal is exposed at a red heat to the action of hydrochloric acid gas, the whole of the phosphorus of the bones is set free, the reaction appearing to take place according to the equation—

$$Ca_3PO_4 + C_4 + 3HCl = 3CaCl + 4CO + H_3 + P.$$

The mechanical arrangements for conducting such a process can be readily devised.

Another process suggested by Fleck is the following:—The bones are treated with cold dilute hydrochloric acid; the solution is evaporated to sp. gr. 1·143. On cooling, this solution deposits crystals of acid phosphate of calcium: these are collected and freed from the mother liquor by pressure between porous stones. The white nacreous mass obtained is mixed with one-fourth its weight of wood charcoal, and distilled for the phosphorus. Neither of these two processes, the report says, has yet been brought into actual use.

Phosphorus, however obtained, requires purification, which is best effected by treating the crude product with sulphuric acid and chromate of potassium, as first suggested by Wöhler. A mixture of these two is added to a melted mass of crude phosphorus, whereby the red and brown products become oxidised, the impurities rising to the top in the form of a scum, while the pure, translucent phosphorus remains at the bottom of the vessel. Another method of purification, which consists in boiling the crude product with caustic potash, is said to yield a very pure article.

The largest amount of phosphorus is now produced in this country, but the Reporter is unable to give any data respecting the quantity. He states, however, that one French house—that of MM. Coignet, of Lyons—turns out 1680 cwts. per annum.

The process for manufacturing *amorphous phosphorus* is not described; but, as most of our readers know, it consists in exposing ordinary phosphorus to a high temperature for a considerable time. An uncertain amount of ordinary phosphorus is always left unconverted, on the complete removal of which the value of the new article entirely depends. This is effected by means of bisulphide of carbon, in which amorphous phosphorus is insoluble; but as it is extremely dangerous to employ large quantities of the bisulphide, the process of purification is carried on as follows:—The crude red phosphorus is only moistened with the bisulphide, and the mixture is then agitated with a solution of chloride of calcium, sp. gr. 1·26—1·38. Heat is afterwards applied, and the bisulphide of carbon, charged with the ordinary phosphorus, rises to the surface, from which it can be easily removed.

M. Coignet effects the purification by boiling with caustic soda ley, which dissolves ordinary phosphorus, converting it into hypophosphite of soda with the evolution of phosphuretted hydrogen. When the evolution of the latter ceases, the residual powder is washed and dried.

A good deal of interesting information respecting lucifer matches is given, but for this we have no space; but we cannot refrain from quoting the concluding paragraphs of this section—*On Lucifer Matches without Phosphorus.*

"The solution of this problem has been attempted by several eminent manufacturers, but their endeavours have not yet led to any satisfactory result.

"The very comprehensive and systematic labours of Wiederhold are beginning to throw more light upon this hitherto somewhat superficially treated branch of chemical technology. From his researches it appears that lucifer matches of good quality may be made with chlorate of potassium and hyposulphite of lead, a result which may prove most valuable should experience show it to be attainable on an industrial scale.

"The total elimination of phosphorus from the lucifer match manufacture would, indeed, be a grand achievement, not merely on sanitary grounds, or as diminishing fire risks, but also because it would liberate, for agricultural purposes, a large quantity of bones now consumed in the preparation of free phosphorus. No worthier object than this could engage the attention of an honourable class of manufacturers; and it is the Reporter's earnest hope that, before the Exhibition of 1872 shall have come round, *phosphorus* matches may be an obsolete appellation."

The Report next treats of several miscellaneous mineral products, an account of which we must postpone.

NOTICES OF PATENTS.

2330. *Improvements in the Manufacture of Ammonia and the Prussiates of Potash or Soda.* W. H. Hutchinson, Newton Heath, near Manchester. Dated August 20, 1862. (Not proceeded with.)

These improvements refer to the manufacture of ammonia and the prussiates of potash and soda from the refuse gluten and nitrogenous matters obtained in the preparation of starch. To obtain the first-named product, the gluten or other matters are submitted to destructive distillation in retorts, with lime, or soda and lime, the gaseous products being collected in suitable condensers. The crude liquor thus obtained may then be purified by neutralising with an acid, filtering the solution, and evaporating to crystallisation or by sublimation. The alkaline prussiates are obtained by fusing the gluten with potash or soda in an iron retort or open vessel. The fused mass is then lixiviated with water, filtered, and the solution crystallised by evaporation and cooling. Or, the prussiates may be obtained by passing the gaseous products disengaged, during the destructive distillation of the gluten, over a mixture of charcoal and potash, or soda, heated to redness in a second retort. The charcoal is then lixiviated as before, in order to furnish the prussiate. The second part of the invention refers to improvements in the apparatus for conducting these processes.

2346. *Soap Powder.* J. Mackay, Glasgow. Dated August 22, 1862.

The specification describes a mode of preparing a granular or crystalline powder, which is very efficacious for washing purposes. It consists of the following ingredients, viz.:—

Soda crystals	20 cwt.
Best pale yellow soap . .	1 ,,
Pearlashes	1 ,,
Black potashes	1 ,,
Soda ash	1 ,,
Sulphate of soda . . .	7 lbs.
Palm oil	7 ,,
Sulphuric acid	7 ,,
Chloride of lime . . .	7 ,,
Water	10 to 20 gallons.

These ingredients are all mixed together, and boiled for about five hours, either by a direct fire or by means of steam, after which the compound is run out into shallow troughs, and cooled with constant stirring.

A soap powder, composed merely of yellow soap and carbonate of soda in the proportions here specified, was known in commerce many years prior to the date of this patent.

2355. *Cleaning Organic Matter.* F. T. Moison, Paris. Dated August 23, 1862. (Not proceeded with.)

This invention consists in a mode of treating wool and other fibrous matters, when charged with oleaginous substances, with the object of separating the latter from the wool or other fibre. This is effected by volatile hydrocarbons, or the bisulphide of carbon, employed as solvents, which are by pressure forced through the wool or fabrics so as to dissolve and carry off the fatty matters, the liquid being afterwards submitted to distillation for the purpose of recovering the solvent for a new application, and for obtaining the fat in a separate form.

2372. *Manufacture of Paper and other Productions in which Fibrous Material is employed.* Henry Harben, Haverstock-hill, London. Dated August 27, 1862. (Not proceeded with.)

This proposal refers to the use of sea-weed, or other aquatic vegetable productions, in the preparation of pulp for paper-making. The weed is first washed in fresh water, and then bleached by treatment with liquid or gaseous chlorine, or a solution of chloride of lime; or, for the purpose of dissolving the colouring matter, steeped in dilute alcohol or wood-spirit. The material is then reduced to pulp by any one of the known processes.

In the *Times* newspaper, and subsequently at the Cambridge Meeting of the British Association, Mr. Harben advocated the policy of instituting a thorough investigation of the weed known under the name of "Zostera marina," the fibres of which, he believed, were capable of being used as a substitute for cotton. This proposal has not yet been turned to practical account in the manufacture of textile fabrics; but the application of such fibres to paper-making appears to have been attended with better success. This idea did not, however, originate with Mr. Harben, inasmuch as a patent for the same invention had already been granted, some fourteen months earlier, to M. Mennons, of Paris. The history of this and other claims referring to Zostera marina as a material for paper-making has been fully discussed at page 214 of our Sixth Volume.

2380. *Producing Light for the Various Purposes of Artificial Illumination.* W. E. Newton, Chancery Lane, London. Dated August 27, 1862.

This specification describes a new mode of producing the lime light, by the employment of jets of coal-gas or hydrogen in combination with others delivering a blast of atmospheric air which has been previously heated to such a degree as will make it serve like pure oxygen as a supporter of combustion. The compound flame is directed in the usual manner upon balls or cylinders of lime to produce a light of great intensity. A second claim refers to the utilisation of heated air in other instances of combustion, particularly in the case of lamps burning oil, or liquid hydrocarbons, and gas flames of every description, which thus become as intensely brilliant as the Bude light.

Much evidence could be adduced in favour of employing a heated current of air as a means of promoting the combustion of oils and fuels; its adaptation to these purposes is happily conceived, and likely to be successful. The principle of the hot blast in urging the combustion of the fuel and in raising the temperature of the furnaces has led to great results in the manufacture of iron.

2421. *Obtaining Light and Heat.* W. Clark, Chancery Lane, London. A communication. Dated September 1, 1862.

This invention refers to an improved method of lighting and heating by means of certain inflammable mixtures of air and vaporised hydrocarbons; also to apparatus suitable for the combustion of the said gaseous mixtures. The fuel employed consists of the following ingredients, viz.:—Benzol, 80 parts; ether, 10 parts; and powdered camphor, 10 parts. These are introduced into a closed vessel, provided with sponge or other absorbent material, and a current of air is then forced through this chamber, which on its escape may, by virtue of its impregnation with the vapour of these inflammable substances, be burnt at a jet exactly in the same manner as coal gas. When adapted to table lamps, the inventor employs a small fan, set in motion by clock-work, for the purpose of generating an air blast, or the heat caused by the combustion of the gas itself may be used as a means of establishing the necessary current of air. The apparatus may be of a diminutive character, and in this form can be applied to walking-canes, cigar-cases, &c. The inventor claims, likewise, the mode of combustion herein described as one suitable for employment with the lighter petroleum and coal oils.

For this last application there are other claimants who have devised as many different plans of impregnation, but all appear to be founded upon the same general principle.*

2426. *Manufacture of Muriate of Ammonia.* W. Hunt, Tipton. Dated September 2, 1862.

The inventor claims a novel mode of manufacturing chloride of ammonium, by passing a current of nitrogen gas or atmospheric air along with the vapour of hydrochloric acid through burning coal or coke; or, in a similar manner, through ignited fuel with which has been previously mixed one of the chlorides of iron or manganese, or any chloride which is capable of yielding chlorine or hydrochloric acid at that temperature.

It is known that small quantities of ammonia are generated whenever air and aqueous vapours are passed through a tube containing ignited coke or charcoal, and we have observed the formation of sal-ammoniac under circumstances in which common salt has been present. A sublimate of chloride of ammonium often collects in the interstices and upon the top of a stack of burning bricks, particularly at an early stage of the operation. With a different object, viz., the elimination of the sulphur, Professor Crace Calvert passes a current of hydrochloric acid vapour through burning coal during its conversion into coke. In some instances, chloride of sodium, instead of hydrochloric acid, has been employed for effecting the same purpose.

2446. *Manufacture of a Blue Colouring Matter.* W. Clark, Chancery Lane, London. A communication. Dated September 4, 1862.

For the production of this blue colouring matter the inventor mixes together equal parts by weight of magenta red and crystallised toluidine, and heats them to the temperature of about 300° Fahr. (or any point between 270° and 324° Fahr.) for a period of five or six hours. The product will consist mainly of the new colouring matter in a pasty condition mixed with the excess of toluidine, which it is advantageous to employ. By treating now with dilute hydrochloric acid (one part of acid to eight or ten parts of water), the whole of this latter basic substance may be dissolved, especially with the aid of heat, leaving the colouring matter in a state of purity, and fit for dyeing and printing when combined with suitable solvents.

The advantage of associating toluidine with aniline in the manufacture of this class of colouring matters was pointed out by Professor Hofmann (*vide* Chemical News, vol. viii., p. 4), and has been already alluded to in our remarks appended to Mr. Nicholson's patent.† It is, perhaps, an open question whether the prior claim of Messrs. Ingham and Wood ‡ includes the use of toluidine in the preparation of their blue colouring matter.

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* *Vide* Chemical News, vol. vii., p. 277.

† *Ibid.*, vol. vii., p. 239.

‡ *Ibid.*, vol. viii., p. 181.

2458. *Manufacturing Gas for Illumination.* S. H. Hadley, Upper Thames Street, London. Dated September 5, 1862.

This claim refers to the production of illuminating gas by passing steam and vaporised hydrocarbons over coke or other carbonaceous fuel heated to redness. A similar mode of proceeding will be found described at page 228 of our eighth volume.

Grants of Provisional Protection for Six Months.

2947. Thomas Carr, New Ferry, near Birkenhead, Cheshire, "Improvements in machinery for amalgamating or intermixing dry, semi-fluid, or aqueous materials, and for agitating solids with liquids for combining, dissolving, or washing the same."—Petitions recorded November 23, 1863.

2949. George Wagstaff Yapp, Clement's Inn, Westminster, "Improvements in the preservation of animal substances."—A communication from Edouard Gorges, Croisic, France.

2954. George Davies, Serle Street, Lincoln's Inn, London, "Improvements in photography."—A communication from Matthieu Risler, jun., Paris.

2959. William Edward Newton, Chancery Lane, London, "Improvements in balloons or aeronautic apparatus."—A communication from Eugene Godard, Rue St. Sebastien, Paris.

2963. George Parkin, Tryddyn, Flintshire, "Improvements in apparatus employed in the manufacture of paraffin and other like oils from shale, cannel, and other minerals."

2967. Louis Accarain, Chancery Lane, London, "Improvements in the manufacture of paper, thread, cordage, and fabrics from beetroot."

2971. Richard Laming, Priory Road, Kilburn, West Hampstead, Middlesex, "Improvements in preparing materials useful in the purifying of gas from sulphuretted hydrogen, carbonic acid, and ammonia, and in making ammoniacal compounds."

2974. James Baker, Temple Street, Whitefriars, London, "Improvements in compositions applicable to the coating of ships' bottoms."

2980. Thomas Gray, Mitcham, Surrey, "A new method of discharging colour from rags used for paper making or other purposes, and in treating of vegetable fibres by such process."

2981. Frederic Page, Birmingham, "Improvements in furnaces and apparatus for the manufacture of volatile hydrocarbons, which improvements are also in part applicable to furnaces and apparatus for the manufacture of illuminating gas."

2987. Heinrich Hirzel, Terminus Hotel, London Bridge, Southwark, Surrey, "Improvements in extracting essences and perfumes, and also oils and fats, from matters containing them, also in bleaching and purifying oils and fats, and in apparatus employed therein."

2988. Samuel Smith and Thomas Smith, Fell Street, London, "Improvements in composition or means for the purpose of destroying insects by fumigation, and in means or apparatus to be employed therewith."

3009. Benjamin Jones, Warrington, Lancashire, "Improvements in separating sulphur from alkali waste."

3012. Jesse Gustavus Redman and George Martin, Brompton, Kent, "Improvements in compounds or compositions for coating or covering iron or wooden ships and vessels, metallic sheathing, telegraph cables, and other objects, to preserve them from decay, fouling, or other destructive action."

3017. George Glover, Ranelagh Works, Ranelagh Road, Pimlico, London, "Improvements in dry gas-meters."

3018. James Thom, Hull, "Improvements in apparatus to be employed in expressing oils and fatty matters."

3023. William Wilson, Manchester, "Improvements in generating gas for illuminating and other purposes, when made by passing atmospheric air over or through volatile oils, and treating such gas and the gas made from coal or cannel after leaving the generators, so as to improve the heating and illuminating qualities thereof, and in the apparatus for effecting the same."

Notices to Proceed.

1882. Edwin Sturge, Walworth, Surrey, "Improvements in coating or protecting metallic surfaces." Petitions recorded July 29, 1863.

1902. Richard Archibald Brooman, Fleet Street, London, "Improvements in dyeing mixed animal and vegetable fibres, whether in a raw or manufactured state." A communication from Theophile Grison, Deville le Rouen, France.

1921. George Stevens, Malvern Cottages, Portland Place North, Clapham Road, Surrey, "Improvements in means or apparatus for effecting a regular supply of air or aeriform fluids for various purposes."

2731. Jean Augustin Barral and Louis Adolphe Cochery, Rue de la Fidelité, Paris, "Certain improvements in the manufacture of manure." Petition recorded November 4, 1863.

2888. William Wigfall and Gottlieb Jolly, Sheffield, "An improved explosive compound to be used in the manufacture of cartridges, and an improved mode of manufacturing cartridges therewith." Petition recorded November 18, 1863.

1941. James Young, Bucklersbury, London, "Improvements in the preservation of animal matter."

1947. Thomas Simmelkiar, Blackrock, Cork, Ireland, and John Ibbetson Spicer, Park Road, Old Ford, Middlesex, "An improved composition for coating or painting the bottoms of ships or vessels, to prevent them from fouling," —Petitions recorded August 6, 1863.

1952. John William Slater, Huddersfield, Yorkshire, "Improvements in the production of yellow and orange colouring matters."

2045. Joseph Arthur, Robert Terrace, Chelsea, Middlesex, "An improved apparatus for the prevention, cure, and relief of hernia of every description, together with prolapsus uteri, uterine hæmorrhage, hernia humoralis, and as a general support for enlargement of the abdomen from whatever cause proceeding."

2053. Richard Archibald Brooman, Fleet Street, London, "An improved method of, and apparatus for, treating molasses, syrups, saccharine juices, and other products." —A communication from Auguste Pierre Dubrunfaut, Bercy, France.—Petition recorded August 18, 1863.

2214. Joseph Lillie and John Haines Waite, Manchester, "An improved composition or coating for the protection and preservation of surfaces of iron, wood, and other materials."—Petition recorded September 9, 1863.

2760. William Daniel Allen, Laithfield House, Norfolk Road, Sheffield, Yorkshire, "Improvements in casting ingots of steel."—Petition recorded November 6, 1863.

2941. James Steart, St. James's Road, Bermondsey, Surrey, "Extracting the fibre from zostera marina and other aquatic vegetable productions."—Petition recorded November 21, 1863.

2967. Louis Accarain, Chancery Lane, London, "Improvements in the manufacture of paper, thread, cordage, and fabrics from beetroot."—Petition recorded November 25, 1863.

2029. Thomas Brooks, Wild's Rents, Long Lane, Bermondsey, Surrey, "Improvements in means or apparatus for the production of charcoal and other products from refuse tan and other woody substances."

2892. Edward Chambers Nicholson, Fenchurch Street, London, "Improvements in the manufacture of colouring matters suitable for dyeing and printing."—Petition recorded November 18, 1863.

CORRESPONDENCE.

Oxalate of Thallium.

To the Editor of the Chemical News.

Sir,—In the Chemical News of January 2, 1864, you state that, in my paper on "Organic Salts of Thallium," I attribute to the neutral oxalate the certainly extremely improbable formula C_4TlO_8. The formula C_4HTlO_8, given for the acid oxalate in one of the following paragraphs, sufficiently indicates that it is an error of the press, and not an error of the analyst, to which the inaccurate formula for the neutral salts has to be attributed. The publication from which you quote is the *Comptes-Rendus.* In the paper printed in the "Mémoires de la Société des Sciences de Lille," which I beg to transmit to you, the formula is printed correctly. I am, &c.

C. F. Kuhlmann, Jun.

The Patent Laws.

To the Editor of the Chemical News.

Sir,—Your correspondent, "Anti-Schemer," seems to be rather astonished at my statement of a simple fact, viz., that "the burglar, the pickpocket, the area sneak, &c.," make precisely the same objections to the laws which protect physical property as certain enterprising men in other trades make to the laws which protect the property of the inventor—that both suffer the same kind of inconvenience from these laws respectively. Upon these very simple and undeniable facts I based a very simple argument, viz., that the laws for the protection of physical property having been found beneficial to society in general by supplying men with a motive to physical industry and economy, and thereby adding to the general wealth of the community, we pay no attention to any suggestions that the burglars, pickpockets, area sneaks, &c., or their friends may make for the abolition of the property laws. In this case, as in many others, we sink the special interests of a particular class in favour of the general interests of the whole community. This being admitted, as it must be, I apply precisely the same principle to the other case, and say, that the laws for the protection of intellectual property having been found of vast benefit to mankind by stimulating ingenious men to make useful inventions and communicate these inventions to their fellow-men, we should pay no attention to the complaints of those other enterprising men who find the patent laws stand in their way, by preventing them from reaping the fruits of another man's labour without paying him for it.

As to the further question of the moral analogy or identity between the two classes of complainants I say nothing, but leave it for "Anti-Schemer" and his conscience to work out as they may.

"Anti-Schemer" illustrates the working of what he calls an absurd law by his own case. He has a tract of land containing certain minerals, and he "learns" that there are two ways of boring to his shale, or whatever it may be—a quick way and a slow way—but the quick, or improved, method is patented by the inventor. He has no objection to use another man's invention—he is very anxious to do so, but he objects to pay him for the use of it. He confesses that he himself will be a great gainer by using the process which he has learned from the inventor, but he thinks it a most absurd law that gives the discoverer and teacher any property in the knowledge created by his own intellect. His disgust is still greater when he proposes to use another man's brains for a method of bringing his mineral to the surface: "A patentee steps in, and says, 'You shall not use my invention without paying me.' Now, surely there was never such an absurd law as this. Was there ever anything so un-English as a law to prevent a man from doing what he likes with his own?" asks indignant "Anti-Schemer." I will answer his question by telling him that there was ever something of this un-English kind in England from the first dawnings of its civilisation, and there ever will be such things in this and every other country as long as its civilisation remains. There was and is a law which prevents the burglar from doing what he likes with his own crowbar, and the pickpocket and area-sneak from doing what they like with their own fingers, when they would like to use that crowbar or those fingers for taking away, without leave or compensation, the fair fruits of another man's skill and industry, or that which his own or his forefather's skill and industry have enabled him to purchase.

For the sake of argument, I have supposed that the mineral belonging to "Anti-Schemer" is a bituminous shale. Now, I happen to have some retorts made expressly for the distillation of such minerals, and I am quite as anxious to get some such mineral to put into these retorts as "Anti-Schemer" is to get his minerals out of the ground; but "Anti-Schemer" and other mineral proprietors "step in," and say, "You shall not use my mineral without paying me." Would "Anti-Schemer" treat me with much respect if I denounced as "absurd" the law which gives him the right to withhold the use of his minerals without payment, and if I insisted upon doing as I liked with my own (retorts), by using his mineral for the filling of them without pay or permission? I can venture to answer for him that he would not; for the whole tone of his letter shows that he has ample respect for his own property, and a full consciousness of his own rights as a proprietor.

He asks, "Is there any relation between the fancies of a schemer's brain and a man's purse?" To such as "Anti-Schemer," there may seem but very little, for he obviously worships the purse, and, by his flippant words, "fancies," and "schemer," he shows that he has but small ability to appreciate the dignity of intellect.

The patent laws do not protect any man's "fancies." Nothing is protected which is not completely and demonstrably practical and useful, and nothing else requires protection. No one can patent a theory, or an abstract or general principle;—nothing but a specific contrivance for a clearly-defined useful purpose. He must prove himself a practical benefactor to his fellow men, in order that his patent shall be valid. Foolish people patent foolish fancies, but they acquire no property in such fancies, and are merely fined for their foolishness in the form of a heavy contribution to the revenue through the Stamp Office, so that we get something even out of these.

But to return to "Anti-Schemer's" question, or rather what he evidently means by the question, viz., "Is there any relation between a patentable invention and a purse?" or, in other words, "Is a man's own invention his own property in the same sense as his land, his purse, or other physical wealth?"

My reply to this is, that it is the same in kind, but very different in degree, inasmuch as the proprietary right to an invention is far stronger that to any physical property; and more especially does this superior strength appear when we compare it with such property as "Anti-Schemer's" "*own*" minerals.

Who made those minerals? Certainly not "Anti-Schemer." Neither did the man from whom he may have bought the land, or his fathers from whom he may have inherited it. Nor can he show any sort of link between himself and those minerals that proves that his and the minerals' Creator made them for him rather than for me, or you, or any other man. The existence of those minerals are utterly and absolutely independent of the existence of "Anti-Schemer." Though "Anti-Schemer" had never been born, those minerals would have existed nevertheless. His rights are purely artificial; man's laws alone have made them his.

But how stands the proprietary relation between the inventor and his invention? He made it, and it is his; without him it was not, and but for him it would not be.

The faculties that immediately created it were given to him by his Creator—by the Creator of all things; he was the appointed agent for that particular work; it was his work, and—subject to the Power that holds all—it is his property. None of your parchments can show a title such as this.

So much for the abstract moral right. Now, let us consider it as a question of legislative policy. Our laws wisely decree that every man shall be protected in the fullest practicable enjoyment of what he has acquired, or his forefathers have acquired for him, whether that be property in money, houses, land, or otherwise; and, with equal wisdom, the law does not go too far back in its inquiries as to the original mode of acquisition, lest it should give rise to vexatious squabblings, and a general insecurity of property, especially of property in land. The politic basis of all this is, that men shall be encouraged in enriching the community by their efforts to acquire wealth for themselves, which efforts they obviously would not make, unless they were secured the peaceable enjoyment of it. Or, to summarise the matter, we may say that society protects the property of individuals, in order to enrich itself.

Now, let us compare such property as the minerals of "Anti-Schemer" with such as the invention of the inventor from this, the politic point of view. Which will afford society the largest gain in return for its protection?

At the outset, then, the minerals are there, whatever society may do, or fail to do, in the way of protecting "Anti-Schemer's" interest in them. Not so with the invention. Its very existence is, in most instances, utterly dependent upon its becoming a protected property. Take the great inventions of James Watt as an example. Without the patent laws they would have been impossible. They cost thousands of pounds, as well as a lifetime in the perfecting of them. Watt had not the means to construct the models and make the experiments, even if he had been foolish enough to devote his life to working for a community that was not honest enough to pay him for his work. Boulton supplied him with the means only because he had a prospect of large profit from holding a share in the patent rights. Let any one calculate how much was gained by Boulton and Watt (well paid as they both deservedly were), and compare that amount with the vast wealth that those inventions have yielded to Britain and to all mankind, and then let him say that the law which, by protecting, created such inventions, was not a good national investment. The history of every other great practical invention, or series of inventions, is but a modified repetition of the same tale. Before the patent laws existed, the very few inventions then made were held by their inventors as secrets; and, from the fear of divulging them, they were not half worked during the inventor's lifetime, and then lost entirely on his death.

If we go a little further, we shall see how the laws for the protection of property prove to be wise laws, even in the case of mineral property, such as "Anti-Schemer's;" for, though the property laws, applied to minerals, could not bring the minerals into existence, as in the case of inventions, they can and do bring them to the surface; for if "Anti-Schemer" were not protected by the law in the proprietorship of these minerals, he would not be so foolish as to spend his money and his labour in boring, sinking, driving, pumping, and raising. No just and reasonable man denies or envies "Anti-Schemer" the possession of all the profits he can fairly gain by his mining efforts, for we are all partners in his profits, inasmuch as he adds to the world's wealth by rendering the hidden treasures of the earth available to man's use; and "Anti-Schemer" should be the last of all men to envy or grudge the inventor his little share, in the form of royalty, when that inventor has, as he confesses, made his task so much easier, so much more rapid, or even, as he intimates, made all the difference between rendering the raising of these minerals a matter of profit or no profit. To say that the inventors of the improved processes for boring and raising stand in his way is simply ridiculous. Had they never existed, he must have used the old way. As it is, he has a choice between that and their inventions. If they ask for the use of their inventions more than their inventions are worth, he is at liberty to do without them; if not, he clearly gains by their inventions, even after paying for them. He talks as though the patent laws were laws for forcing him to use new inventions and to pay royalties upon them.

The wild communists who raised the cry that "property is theft," were marvellously stupid and not particularly just. Those who are now feebly attempting to raise a crusade against inventors' property are equally shallow and still more unjust; for the communists did propose to rob all alike, while the anti-patent people propose to rob only one class with the supposed object of enriching one other by the spoil. Doubtless the patent laws are defective and improvable; but if we are to abolish all laws that are not perfect, we must return to a state of very primitive simplicity.

I am, &c.
W. Mattieu Williams.

Oak Alyn, near Wrexham, January 9, 1864.

MISCELLANEOUS.

THE BATTLE OF THE CHLORODYNES.

Vice-Chancellor's Court, Jan. 11.
(*Before Vice-Chancellor Sir W. P. Wood.*)

BROWNE *v.* FREEMAN.

Mr. Giffard, Q.C., and Mr. Fischer moved for an injunction to restrain the defendant from selling any medicine, not being chlorodyne of the plaintiff's manufacture, under the name of "The Original Chlorodyne," or under any other name so contrived as by colourable imitation or otherwise to represent the article to be chlorodyne manufactured by the plaintiff.

The case made by the bill was that the plaintiff, Dr. John Collis Browne, while serving as an assistant-surgeon with the Queen's army in India, invented, about 1846, an entirely new medicine, which, as he stated, was used with great success in cases of fever, dysentery, cholera, and other diseases incident to an Asiatic climate. The term "chlorodyne," which was invented by the plaintiff, not by way of explaining the composition or properties of the compound, but as a fancy name to be used as a trade mark, was first applied by him to his medicine in 1855, and under this title the compound became widely known, and appears to have acquired great reputation. In 1858, the plaintiff being desirous of securing the exclusive right to use the word "chlorodyne," registered at Stationers'-hall a label headed—"Dr. J. Collis Browne's Chlorodyne," and also containing the words, "the only genuine chlorodyne." In October, 1861, the attention of the plaintiff was called to a circular issued by the defendant Freeman, who describes himself as a "Pharmaceutist," in the Kennington-road, to the effect that he had "for several years made and used extensively in his business an article which had lately been named 'chlorodyne,'" and had determined to prepare it on a larger scale than heretofore, and introduce it to the medical profession, &c. In May, 1862, the plaintiff filed a bill against the defendant to restrain him from using the term "chlorodyne," but being advised that it was doubtful if he could prevent the defendant from selling his medicine as "Freeman's Chlorodyne," obtained an order in November, 1862, dismissing that bill with costs.

The defendant had latterly, however, advertised himself as the first inventor, in 1844, of chlorodyne, and advertised his medicine as "The Original Chlorodyne," appending a statement to the effect, that it was proved by the increasing demand in the profession to be "a superior and more reliable preparation than any which has been produced by other makers," and adducing medical testimonials to its invaluable qualities, and that it was "quite as efficacious in all cases as the medicine known as 'Collis Browne's Chlorodyne.'" The plaintiff had thereupon filed the present bill to restrain the use of the term "Original Chlorodyne" by the defendant, as being calculated to mislead the public into the belief that his medicine was that of the plaintiff, and fraudulently to injure its sale and reputation. Evidence in support of the plaintiff's case had been given by physicians, druggists, &c., to the effect, that the plaintiff's medicine was generally known in the profession as chlorodyne simply, and that when chlorodyne was prescribed the plaintiff's medicine would be alone intended. The name was also stated to be merely fanciful; and one of the witnesses, a physician of eminence, when the compound was first brought to his attention, actually protested against the name as absurd and preposterous, meaning, if anything at all, "green pain," and begged the plaintiff "not to strangle" his medicine by sending it out into the world under such a title.

The defendant's case was, in substance, that the ingredients of the medicine sold by him as chlorodyne were known to him as long ago as 1844, and that the term was not one in which a trade mark could be claimed, as it expressed the character and main ingredients (chloroform and anodynes) of the composition. The defendant also stated that he had carefully distinguished the chlorodyne sold by him by attaching his own name, and using a different label and advertisement from that of the plaintiff; and that, although he had used the compound from 1844 to 1859 as a remedy, he had not advertised it or sold it to any extent before the latter year, as he did not till then fully appreciate its value. In reference to his use of the term "Original Chlorodyne," which had led to the present suit, he stated his belief that he was, in fact, the first inventor and discoverer of it, but denied any intention to represent that his compound was that of the plaintiff. Evidence of physicians and others was also adduced for the purpose of showing that the name would be understood as denoting the qualities of the composition, and not as a special title or trade mark to which the plaintiff was alone entitled, and that it was usual in prescriptions to specify what chlorodyne, whether Browne's or Freeman's, was to be supplied.

The Vice-Chancellor said that the case was one of very grave suspicion, but he doubted whether it was sufficiently made out so as to enable him to do anything until the hearing of the cause. The plaintiff had placed himself in a difficulty by abandoning the first suit that he had instituted, and getting the bill dismissed with costs. It was by no means clear that the term "chlorodyne" was not one of so fanciful and whimsical a nature as to be original, and to entitle the plaintiff to its exclusive use. There was strong evidence that persons asking for chlorodyne alone would be supplied with that manufactured by the plaintiff; but then there was also other chlorodyne in the market, and a careful shopman would ask the customer which he wanted—whether Browne's or Freeman's. Although it was so far favourable to the defendant that the word "Original" did not appear upon the outside of the wrapper, still he had by no means justified the use of the term. Chlorodyne *simpliciter* would mean that made by the plaintiff, and for this reason, that it was known in the market under that title before the defendant had ever thought of using the word. *A fortiori*, therefore, when the term "Original" was applied to the article, people would think that it must mean that which was manufactured by the plaintiff. The successive alterations in the advertisements led to a very strong suspicion that there had been a gradual course of proceeding for the purpose of getting the name "Original" attached to the defendant's medicine, and thus misleading people into the belief that they were buying that of the plaintiff. But it was not shown that any one had been deceived by the label of the defendant, or that any one had asked for "Original Chlorodyne," and been misled into the belief that he was purchasing that of the plaintiff. If the defendant advertised himself as the original inventor, people who asked for "Browne's Chlorodyne" were not necessarily deceived, as the defendant simply said that his medicine was better than Browne's. That was a question, however, with which he could not deal; although if it had been shown that any one had been deceived, there was enough on the bill to sustain the injunction: he was not justified in summarily interfering as the case now stood. The motion would stand over until the hearing; and if the bill were dismissed in the meantime, the costs would be costs in the cause.

Royal Institution.—Tuesday, January 26, three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Thursday, January 28, three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Friday, January 29, eight o'clock, W. R. Grove, Esq., Q.C., "On Boiling Water." Saturday, January 30, three o'clock, John Lubbock, Esq., F.R.S., "On the Antiquity of Man."

Royal Institution of Great Britain.—Probable arrangements for the Friday evening meetings before Easter, 1864;—

January 22. W. R. Grove, Esq., Q.C., F.R.S., "On Boiling Water."

January 29. Professor Frankland, F.R.S, "On the Glacial Epoch."

February 5. J. A. Froude, Esq., M.A., "On the Science of History."

February 12. Professor Wanklyn, "On the Synthesis of Organic Bodies."

February 19. W. S. Savory, Esq., F.R.S., "On Dreaming and Somnambulism, in their relation to the Functions of certain Nerve-centres."

February 26. J. Prestwich, Esq., F.R.S., "On the Quaternary Flint Implements of Abbeville, Amiens, Hoxne, &c., their Geological Position and History."

March 4. Professor Stokes, Sec. R. S., "On the Discrimination of Organic Bodies by their Optical Properties."

March 11. The Rev. W. H. Brookfield, M.A., "On the Use of Books."

March 18. Professor Tyndall, F.R.S.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read: "Absorption of Mixed Gas in Water." By W. M. Watts, Esq. "On Urochrome." By Dr. Thudichum.

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

M. B.—Apply to the Secretary of the Society.

W. B.—The process is not yet published.

Photo.—There is but one mode, that given in chemical books, which is carried out on a large scale, with no peculiar arrangements.

Received.—M. de La Peyrouse, next week; A. Guyard.

H. H.—The simplest way of analysing blue pill is to boil with hydrochloric acid, and precipitate the mercury with protochloride of tin.

Reader.—The separation has been attempted by placing the substance in contact with finely-divided silver, and heating the mixture. It must be done, with precaution, in a closed tube.

Chlorine.—There is no work which treats of the manufacture on a large scale. The process given in the Pharmacopœia may be conducted, with care, on a considerable scale.

Books Received.—Chemistry, Chambers' Educational Course; Galloway's Second Step in Chemistry.

THE BRITISH PHARMACOPŒIA.

The Pharmacopœia is now completed and printed, and the issue is only delayed until enough copies have been bound to supply at once the immediate demand. We have for some weeks been in possession of the principal novelties in the work, but have refrained from printing them until the work was really published. But as parts have now found their way into the professional prints, and as we are told that at some establishments the new preparations are all made, and bottles labelled ready to place on the shelves the moment it is telegraphed that the Pharmacopœia is out, we need no longer observe any delicacy.

The great delay in the publication of the work is ascribed in the Preface to the following causes:—

"Numerous researches in chemistry, pharmacy, and natural history, and into the value of old and new remedies, carried on with the complex machinery of a Committee in each of the three divisions of the kingdom, necessarily occupied much time. To these, the principal causes of delay, were added difficulties arising from the present state of the law of copyright, which obliged the Council to apply to the Legislature for an Act of Parliament to enable them to give authority to the British Pharmacopœia, and to secure a title in the copyright. Further delay was subsequently occasioned by the necessity of altering, in deference to the general wish of the medical profession, the pharmaceutic weights which the Committee had previously adopted in the composition of the work."

This statement, while fully accounting for the delay, hardly explains the cost of the book, which is set down by a contemporary at 6000*l.*, but which, we are informed, will more probably amount to 8000*l.* That matter, however, only concerns the profession whose money the Council spends.

The book will be issued in two forms—one at 10s. 6d., the other at 6s. At present, we see no other edition announced, but, no doubt, several will be published, with useful annotations, within a short time of the first issue. The Medical Council, as we have seen, succeeded in obtaining an Act of Parliament to secure them a copyright in the bare work; but there will, of course, be no difficulty in constructing a book to which that Act cannot possibly apply. There are, indeed, grave doubts whether such a thing as a copyright can exist in any work, such as a pharmacopœia or an Act of Parliament, which is binding on any section of the community. There is no necessity, however, for any enterprising author to try the question. Notes and omissions make an entirely new book.

While at this point, we may as well explain the plan we intend to follow in the remarks we shall proceed to make on the work. In the present number we have given a list of most of the new preparations, and of the alterations of names from the last London Pharmacopœia. In our next notices we shall give a detailed account of the novelties introduced. We shall then proceed to notice the new methods and processes which have been given for preparations under the old names, and also the differences of strength which have been made in some preparations. The following extract from the Preface to the Pharmacopœia, will show that some of these are important:—

"Thirdly, an attempt has been made to assimilate the strength of preparations of the same pharmaceutic form, in order that they may be prescribed in similar doses. The Council regret that difficulties of detail have hindered their Committee from carrying out this principle systematically, because uniformity of medicinal strength in preparations of similar form would be a great safeguard against dangerous mistakes, as well as a great facility alike to the prescriber and dispenser. Nevertheless, the contemplated improvement has been effected extensively, especially in the preparations where it was most required. Thus, among the tinctures, those made with dangerous ingredients are, with few exceptions, brought to one standard of strength, so that an ordinary dose is from fifteen to twenty-five minims; while all tinctures made with substances of no great activity are left, as formerly, uniform in strength, so that an ordinary dose is from one to two fluid drachms."

Uniformity of dose will undoubtedly be a safeguard for prescribers with short memories, but we do not see how it will facilitate dispensing. Nevertheless, we regard the change as a decided improvement.

From what we have said above, it will be seen that our notices will contain an epitome of all that is new in the book; and, considering the importance of the matter to a large section of our readers, we shall proceed with these notices as early as possible.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Solubility of Some Thallium Salts,
by William Crookes, *F.R.S.*

The following table is the result of many careful experiments. The figures may be relied upon as accurate:—

One part of Thallium		Water at 60° F.	Boiling water.
Protochloride	dissolves in	283·4 parts.	52·5 parts.
Sesquichloride	,,	380·1 ,,	52·9 ,,
Iodide	,,	4453·0 ,,	842·4 ,,
Platinochloride ...	,,	15585·0 ,,	1948·0 ,,
Sulphate	,,	21·1 ,,	5·4 ,,
Nitrate	,,	9·4 ,,	— ,,
Carbonate ...	,,	24·8 ,,	3·6 ,,
Oxalate	,,	69·3 ,,	11·0 ,,
Binoxalate ...	,,	18·7 ,,	— ,,
Phosphate ...	,,	201·2 ,,	149·0 ,,
Terchromate ...	,,	2814·0 ,,	438·7 ,,

The nitrate and binoxalate dissolve in considerably less than their own bulk of boiling water, forming a syrupy solution.

The insolubility of the platinochloride is remarkable. It may be of interest to compare it with the corresponding potassium, ammonium, rubidium, and cæsium salts:—

One part of Platinochloride of		Water at 60° F.	Boiling water.
Potassium	dissolves in	108· parts.	19· parts.
Ammonium	,,	150· ,,	80· ,,
Rubidium ...	,,	740· ,,	157· ,,
Cæsium ...	,,	1308· ,,	261· ,,
Thallium ...	,,	15585· ,,	1948· ,,

Researches on Quinoline, by M. Hugo Schiff.

Quinoline combines with metallic salts, and furnishes compounds similar to anilometallic combinations.

If we admit the presence of a triatomic radical $Ȼ_9'''H_7$, in quinoline $Ȼ_9H_7N$, the general formula of monometallo-quinic compounds will be—

$$N\left\{\begin{matrix}Ȼ_9'''H_7\\M\end{matrix}\right\}X = Ȼ_9H_7N,MX,$$

in which X represents an acid radical. For the most part, these compounds are crystallised, and slightly soluble in cold water. Prolonged boiling is necessary to decompose them. Exposed to air and sun, they become slightly yellow. Combinations with tri and tetratomic metals are obtained with difficulty, and decompose easily.

Hydrochlorate of zinco-quinoline—

$$\mathrm{N}\left\{\begin{matrix}\text{Ꞓ}_9{}'''\mathrm{H}_7\\ \mathrm{Zn}\end{matrix}\right\}\mathrm{Cl} = \text{Ꞓ}_9\mathrm{H}_7\mathrm{N},\mathrm{ZnCl},$$

is prepared by direct addition, and crystallises from the hot solution in small and apparently monoclinic prisms. We have, besides, obtained the hydrobromate and hydriodate. Cadmium forms perfectly analogous combinations.

With nitrate of mercury, quinoline gives a white precipitate, nitrate of mercuro-quinoline,—

$$\mathrm{N}\left\{\begin{matrix}\text{Ꞓ}_9\mathrm{H}_7\\ \mathrm{Hg}\end{matrix}\right\}\mathrm{N}\text{Ɵ}_3$$

little soluble in pure water, but much more so in boiling water, with a little nitric acid. This solution deposits the crystalline salt without decomposing it. Prolonged boiling transforms the salt into polymercuro-quinolic compounds. Potash colours it yellow; and it becomes brown when heated. The salt is transformed into a viscous mass, while part of the quinoline volatilises with the aqueous vapour. The nitrate of mercuro-quinoline assists in the double decomposition with the alkaline salts; but the reaction is more precise if the acetate is used. A solution of acetate, heated with the alkaline salts, gives, on cooling, the crystalline salts of different acids. By this method I have obtained hydro-chlorate, -bromate, and -iodate, sulphate, and chromate of mercuro-quinoline. All these salts are easily decomposed by raising the temperature. The yellow chromate is transformed at 100° into a viscous mass.

Hydrocyanate of mercuro-quinoline,—

$$\mathrm{N}\left\{\begin{matrix}\text{Ꞓ}_9\mathrm{H}_7\\ \mathrm{Hg}\end{matrix}\right\}\mathrm{Cy} = \text{Ꞓ}_9\mathrm{H}_7\mathrm{N},\text{Ꞓ}\mathrm{HgN},$$

obtained by direct addition, crystallises, from its aqueous solution, in long brilliant prisms. This compound is attended by none of the phenomena of dissociation belonging to hydrocyanate of mercuraniline.

Bichloride of tin, as also the trichlorides of bismuth, antimony, and arsenic, combine directly with quinoline; but these combinations do not possess the remarkable stability of corresponding combinations of aniline.

Towards acids, metallo-quinolic compounds behave like metallanilides. With the exception of mercuro-quinoline, the salts furnish, by decomposition, double compounds, well crystallised and soluble, without decomposition, in acidulated water. The composition of these double salts is not analogous to that of double salts of aniline. While the latter always contain a number of equivalents of aniline equal to the atomicity of the metal, the number of equivalents of the base in double salts of quinoline is often less than that of the atomicity of the metal. We will quote only the following formulas of double chlorides:—

Zinco-quinolic chloride .	. $\mathrm{ZnCl},\text{Ꞓ}_9\mathrm{H}_8\mathrm{NCl}$.
Stibio-quinolic chloride .	. $\mathrm{SbCl}_3,\text{Ꞓ}_9\mathrm{H}_8\mathrm{NCl}$.
Stanno-quinolic chloride .	. $\mathrm{SnCl}_4 2\text{Ꞓ}_9\mathrm{H}_8\mathrm{NCl}$.
Bismo-quinolic chloride .	. $\mathrm{BiCl}_3 3\text{Ꞓ}_9\mathrm{H}_8\mathrm{NCl}$.

Quinoline becomes red when combined with cyanogen. We reserve for some future occasion the results of our researches on other quinolic combinations, and on the decomposition of metallo-quinolic compounds.—*Comptes-Rendus*, lvii., 837, 63.

Solubility of Nitrate of Soda in Water, by M. Maumene.

100 parts of water disssolve at—

0° C. . .	70·94	parts of the	fused nitrate.
10° . .	78·57	,,	,,
20° . .	87·97	,,	,,
30° . .	98·26	,,	,,
40° . .	109·01	,,	,,
50° . .	120·00	,,	,,
60° . .	131·11	,,	,,
70° . .	142·31	,,	,,
80° . .	153·72	,,	,,
90° . .	165·55	,,	,,
100° . .	178·18	,,	,,
110° . .	194·26	,,	,,
119·4° . .	213·43	,,	,,

The above are the mean results of five experiments at each different temperature.

TECHNICAL CHEMISTRY.

The Absorbent Power of Starch for the Coal-Tar Colours, by J. W. Young.

By adding wheaten starch to a dilute, cold, aqueous solution of mauve, magenta, azuline, &c., the colouring-matter is absorbed, and the supernatent liquor rendered nearly colourless, when left in contact for a few hours, with occasional agitation to ensure an equal absorption of the colouring-matter by the starch.

In the case of azuline, a moderately-strong solution was prepared, and treated with starch as above; every trace of blue was absorbed, and the supernatent liquor had a reddish tinge, due to the red colouring-matter which generally accompanies solutions of azuline. When a more dilute solution of azuline was used, every trace of colour was absorbed, and the liquor on filtration was clear and perfectly colourless.

The most of the colouring-matter may be removed from the starch again by solution in alcohol.

By this process almost every variety of colour may be procured—yellow, pink, various shades of red, blue, mauve, &c.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

The following list, we believe, will be found to include most of the alterations of names in what we must now call the late London Pharmacopœia, and also the additional preparations now for the first time introduced into the National Pharmacopœia. Several preparations, the old names of which are retained, have been altered in strength; and to each of these we shall call attention as we go through the book:—

Old Names.	*Additions and New Names.*
Acidum aceticum.	Acidum aceticum glaciale.
	Acid. sulphurosum.
Antim.-pot. tartras.	Antimonium tartrat.
Mistur. camphoræ.	Aqua camphoræ.
	Confectio sulphuris.
	,, terebinth.
	Extract. colocynth. co.
	,, calumbæ.
	,, ergotæ liquid.
	,, opii liquid.
	,, pareiræ liquid.
	Fel bovinum.

Old Names.	*Additions and New Names.*
	Ferri arsenias.
	,, oxidum magneticum.
	,, sulphas granulat.
	Ferrum redactum.
Hydrarg. ammon. chlor.	Hydrargyr. ammoniat.
,, nitrico oxyd.	Hydrargyr. oxyd. rubr.
	Infusum aurantii.
	,, catechu.
	,, cusso.
	,, dulcamaræ.
	,, ergotæ.
	,, matico.
	,, senegæ.
	,, sennæ.
	,, uvæ ursi.
	Liniment. aconiti.
	,, belladonnæ.
	,, cantharidis.
	,, chloroform.
	,, crotonis.
	,, iodii.
	,, terebinth. acet.
Liq. potass. arsenit.	Liquor arsenicalis.
	,, atropiæ.
	,, calcis saccharat.
	Liq. hydrarg. nitrat. acid.
	,, potassæ permangan.
	,, sodæ arseniatis.
Liq. sodæ chlorinatæ.	,, sodæ chloratæ.
	,, strychniæ.
	Mistura creosoti.
	,, scammonii.
Mistura acaciæ.	Mucilago acaciæ.
	,, amyli.
	,, tragacanthi.
Myristicæ oleum.	Myristicæ adeps.
	Pil. aloes Barbadoes.
	,, socotrin.
	,, et assafœtid.
Pil. galbani co.	Pil. assafœtidæ co.
	,, calomel co.
	,, colocynth et hyoscyam.
Pil. ferri co.	,, ferri carbon.
	,, ,, iodidi.
Pil. saponis co.	,, opii co.
	Potassæ permangan.
Potassæ bitart.	,, tartras acid.
Pulv. cinnam. co.	Pulvis aromaticus.
	,, catechu co.
Pulv. cretæ co.	,, cretæ aromat.
,, ,, c. opio.	,, ,, aromat. c. opio.
,, ipecac. co.	,, ipecac. c. opio.
,, kino co.	,, kino c. opio.
	,, rhei co.
	Spirit. cajeputi.
	,, chloroformi.
Spt. ether nitrici.	,, ether nitrosi.
	,, juniperi.
	Succus conii.
	,, scopariæ.
	Suppositor. acidi tannici.
	,, morphiæ.
	Syrup. hemidesmi.
Syr. rosæ.	,, rosæ gallicæ.
	Tinct. bucco.
Tinct. camphor. co.	,, camphoræ c. opio.
,, catechu co.	,, catechu.
	,, chirettæ.
,, colchici.	,, colchici semin.
,, conii.	,, conii fruct.
	,, croci.
,, sesquichlor.	,, ferri perchlor.
,, iodinii co.	,, iodinii.
	Tinct. sabinæ.
	,, senegæ.
Tinct. sennæ co.	,, sennæ.
,, valerianæ co.	,, valerian. ammon.
	Trochisci acidi tannici.
	,, bismuthi.
	,, catechu.
	,, morphiæ.
	,, morph. et ipecac.
	,, opii.
	Ungt. aconitiæ.
	,, atropiæ.
	,, calomel.
	,, cocculi.
Ungt. gallæ co.	,, gallæ c. opio.
,, hydr. ammon. chlor.	,, hydrarg. ammoniati.
	,, ,, iodid. rubri.
,, ,, nitric. oxyd.	,, ,, oxyd. rubri.
	,, plumbi carbonat.
Cerat. plumbi co.	,, ,, subacet.
,, resinæ.	,, resinæ.
	,, simplex.
	,, terebinthinæ.
	,, veratriæ.
Ungt. zinci.	,, zinci oxidi.
Vin. antim. pot. tart.	Vin. antimoniale.
	Zinci valerianas.

Some of these changes of name will seem to our readers altogether uncalled for. Why, for example, should Pil. galbani co. for the future be called Pil. assafœtidæ co.? Great confusion also will arise from having an *Ext.* coloc. co. as well as *Pil.* coloc. co., inasmuch as prescribers have scarcely got into the habit of prescribing the pill when they meant the old extract. Other changes are open to graver objections; but these we shall leave until we have the entire work before us.

The Weights and Measures of the British Pharmacopœia.

As was long ago announced, the Medical Council have adopted the avoirdupois pound and ounce in the new Pharmacopœia. The reasons for it are given in the following extract from the preface to the work. It will be seen that the fluid measure remains the same:—

"Under any circumstances it would have been necessary on this occasion to revise the pharmaceutic weights and measures of the kingdom. But change became imperative for one division or another of the country, as the Dublin College of Physicians, in their last Pharmacopœia, had led the way by adopting for the first time in pharmacy the imperial weights for the ounce and higher denominations; a departure from long established usage which appeared to the Council judicious and worthy of imitation.

"The three Colleges had long agreed in adopting the imperial measures for every denomination above the fluid ounce. For the latter denomination a convenient subdivision had been also based on the old pharmaceutic principle, that each fluid ounce should consist of eight parts, called fluid drachms, and each of these of sixty parts, called minims. It was impossible to improve that now familiar division.

"The Council, in resolving to adopt for pharmacy the imperial ounce and pound, could not assimilate the subdivision of the ounce to that of the fluid ounce, without substituting a new medical grain for the troy grain, hitherto the medical as well as the standard grain of the kingdom. This alteration they did not consider advisable; it has, therefore, appeared to them a necessary consequence, that the drachm and the scruple, the old denominations of weight between the ounce and grain of pharmacy, must be abandoned, since they can no longer exist as both simple multiples of the latter, and integral parts of the former. Accordingly, all who prescribe and dispense medicines are recommended to discontinue henceforth the use of the drachm and scruple weights.

"The weights and measures of the British Pharmacopœia with their symbols will now stand as follows :—

"Weights.

1 pound	...	lb.	...	=	16 ounces	=	7000 grains.
1 ounce	...	oz.	...	=	...	=	437·5 grains.
1 grain	...	gr.	...	=	...	=	1 grian.

"Measures.

1 gallon	...	C.	...	=	8 pints	...	O. viij.
1 pint	...	O.	...	=	20 fluid ounces		fl. oz. xx.
1 fluid ounce		fl. oz.	...	=	8 fluid drachms		fl. drs. viij.
1 fluid drachm		fl. drm.		=	60 minims	...	min. lx.
1 minim	...	min.	...	=	1 minim	...	min. j."

These changes in the weights need not occasion dispensers much trouble. Doubtless, cases will often happen in which it may be open to question whether the troy or avoirdupois ounce is meant; but it can rarely happen that the substitution of either for the other will be of material consequence. Although the drachm and scruple are here omitted from the table, there is no doubt that these weights will be continually used, and it is only necessary to remember that they retain their value in grains, but are no longer aliquot parts of the ounce.

PHYSICAL SCIENCE.

The Ultra-violet Rays of the Solar Spectrum, *by* M. Mascart.

The method of obtaining these rays is precisely that used for observing the luminous spectrum. I used a goniometer, with collimator and two lenses of quartz cut perpendicularly to the optical axis, so that the rays traverse them in directions very little inclined on this axis. The refracting prism is also of quartz, cut parallel with the axis, and I generally observed the principal spectrum, which is the most deviating. A system of lenses like this is entirely deprived of achromatism, but this effect does not prevent the production of a pure spectrum, and has no other effect than to cause a considerable change of position when passing from the less refrangible to the more refrangible rays. The mounting of the eye-piece is furnished with a net-work of cross threads, and the eye-piece itself, at its interior extremity, has a photographic plate, with its sensitive face exactly behind the net-work, so as to take the impress of the phenomenon produced on its plane.

By this means the chemical region to be explored can, even though invisible, be rapidly brought to view. It is only necessary to produce on the plane of the net-work a defined image of the extreme limit of the luminous spectrum, of the ray H, for instance; the eye-piece is then pushed in a little further to bring the point towards the more refrangible parts, and an experiment is made by substituting for the eye-piece of the lenses the photographic eye-piece. Examination of the result indicates in what direction the net-work requires to be displaced. The want of achromatism of the lenses admits of clear results only within confined limits, and, as the energy of the action is very unequal in different parts, the time of exposure ought also to vary; it is then necessary to multiply the experiments, and no less than eight trials are required to produce the entire chemical spectrum.

It is obvious that a high degree of perfection of detail may be attained, as the rays concentrated on a very small surface always possess sufficiently energetic action, however small the chink may be. I used collodion sensitive enough to give an ordinary photograph in five or six seconds, and the time of exposure in my experiments has never exceeded a minute and a-half. The proofs obtained may be put into a solar microscope, and enlarged positives taken, but the results are mediocre; it is better to examine them by the microscope, to measure the distances of the rays with a micrometric screw mounted on the object-glass, and to draw them very carefully. I obtained my chart in this way; the distances are not exactly proportioned to the deviations, on account of the small variations in thickness. I have more especially endeavoured to reproduce the general aspect, the form of each group, with the relative intensities of the rays.

Some physicists, notably MM. Ed. Becquerel, Stokes, and Esselbach, are already occupied with this question, and have indicated by letters the principal groups of rays. Their denominations do not always accord; the charts are sometimes so imperfect as to make it difficult to recognise them, and, besides, names have been given both to the dark and to the brilliant places. I have taken as a guide the plate published by M. Müller in his "Traité de Physique," applying each letter to the most remarkable dark ray in the group it served to indicate.

To give an idea of the precision attainable, it will suffice to remark that the luminous spectrum drawn by Fraünhofer comprehends 320 rays, from A to H, and that in an angular space about equal to that from H to S, I found more than 280: the results are then comparable to those obtained with the sun. The dispersion may be increased by multiplying the refracting prisms, as M. Kirchoff has done, for observing in the same way the brilliant chemical rays of coloured flames, and comparing them with the obscure rays of the solar spectrum. When circumstances allow me I propose to return to this subject.

To conclude, the measure of the differences in the length of the wave may be made with adequate exactness. The net-work which is before the sensitive plate is projected and engraven on the proofs; we thus identify the ray corresponding to the deviation observed. By arranging a great many similar measurements along the whole length of the chemical spectrum, we may easily, by the help of a chart, fix the deviation of a ray, situated between two positions of the net-work. The lengths of the wave are measured with the same facility. I have obtained very satisfactory results with a net graduated to 440 c. of a millimetre; but I dare not now venture to publish the numbers, as in measuring the lengths of the luminous rays I have arrived at results differing too much from those of Fraünhofer to be accepted without numerous verifications.—*Comptes-Rendus*, lvii., 789, 63.

Soap for Very Dirty Skins.—Under this title E. Janota gives the following receipt:—Two pounds of finely rubbed carbonate of magnesia are to be mixed in a porcelain dish with eight pounds of water-glass and eight pounds of rain water. To these four pounds of oleic acid are added, and the whole is gently warmed and stirred as long as carbonic acid is evolved. Lastly, a pound of crystallised carbonate of soda dissolved in some warm water is added, and the mass is dried and made into shapes. The water-glass need not be diluted, as, on mixing it with carbonate of magnesia, carbonate of potash is formed, which perfectly saturates the oleic acid.—*Chemisches Centralblatt*, No. 54, 1863.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

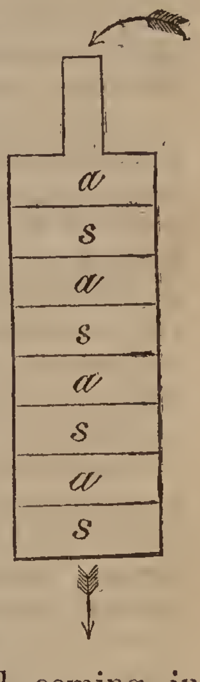
Lecture III.—*Thursday, December 17, 1863.*

Ladies and Gentlemen,—At our last meeting I directed your attention especially to the subject of alumina, a base consisting of a metal termed "aluminium" and of oxygen. It exists extensively diffused through nature, and is the essential constituent of all clays, or, at all events, I should say, *an* essential constituent of all clays. It exists in nature beautifully crystallised, and is then known as corundum. When coloured blue, it is termed sapphire—when red, ruby. Sometimes this corundum occurs opaque from the presence of impurities, and then we have it in the form of common emery. In the laboratory of the chemist dried alumina is known simply as a white amorphous powder, excessively insoluble and infusible. Having described the physical and chemical properties of alumina, we proceeded then to examine certain methods by which it can be obtained in a crystalline form, and I directed your attention especially to the plan of Ebelmen, and showed you a specimen of alumina crystallised by his method. It consists in heating alumina for a long time at a high temperature in a platinum vessel with borax. The borax first of all dissolves the alumina, and then the elements of the borax separate therefrom and volatilise, and leave the alumina in a crystallised state. We next examined another method by which alumina can be crystallised, by which it can be obtained blue, red, or green—namely, by bringing the colourless gas, fluoride of silicon, in contact with the vapour of boracic acid at a tolerably high temperature. Mutual decomposition takes place, fluoride of boron escapes, and the alumina is left distinctly crystallised. The colours, both red and blue, are communicated by a small quantity of chloride of chromium; and it is remarkable that the same colouring matter, that is, chloride of chromium, should, under apparently identical conditions, communicate sometimes a red and sometimes a blue colour. We will now pass on to consider further this part of our subject.

In the first place I shall direct your attention to a singular and beautiful mineral known as "staurolite," which has been prepared artificially.

Let me just say one word by way of caution. It does not follow that the methods by which we can prepare mineral matters crystallised in the laboratory, should be precisely those which Nature herself has adopted on a great scale, though in many cases there is no doubt that the processes which we have employed in the laboratory are really identical with those which Nature herself has employed. Then, again, there is another very important point which we should bear in mind. The same mineral substance may be produced by methods entirely distinct. I shall show you by-and-by the well known and beautiful mineral termed "felspar," which can be produced both by the agency of liquids at a tolerably high temperature, and also directly by igneous fusion. I shall present to you specimens of magnificently crystallised felspar taken from furnaces, where there is no doubt about the mode of its production.

And now for this mineral, staurolite, which is a silicate of alumina. We are indebted to Deville for a singular experiment regarding the formation of this mineral. It does not at all follow that the process I am about to call your attention to should be exactly that which Nature herself has adopted, but still it is remarkably illustrative of what may occur, and on that account I bring it in some detail before your attention. We take a porcelain tube, and place it vertically in a furnace. It is open at both ends, and we introduce through the upper part of the tube the gas, fluoride of silicon. At the top we have a layer of alumina, which I will designate by the letter A; then there is a layer of silica which I will designate by the letter S; and so on in alternation—alumina, silica, alumina, silica—beginning with alumina, and finishing with silica. We will heat that tube to red whiteness, and then note the result. The gas, fluoride of silicon, is a compound of fluorine and silicon. When it comes in contact with the alumina a curious reaction takes place. A portion of the silica is deposited here, and we get the mineral silicate of alumina, a corresponding proportion of the aluminium being displaced and volatilised in the form of fluoride of aluminium. It is important clearly to understand this part of the operation. You perceive that we bring fluoride of silicon in contact with alumina, that is, with a compound of aluminium and oxygen. A reaction takes place between those two substances at this temperature, whereby silicate of alumina is produced. The mineral, staurolite, happens to be this particular silicate of alumina, and fluoride of aluminium is evolved. That descending, and coming in contact with the stratum of silica beneath, undergoes a change similar to that which the fluoride of silicon underwent in the first instance, and we get the same mineral formed in the second layer from silica as was formed in the first layer from alumina—in one instance by the action of fluoride of silicon, and in the other by the action of fluoride of aluminium. At the second decomposition there is fluoride of silicon evolved, which acts upon the aluminium below exactly as in the first instance, and so it goes on in succession, and at length you obtain the tube full of the mineral, staurolite—this silicate of alumina, and yet you have only employed a small amount of fluoride of silicon in the first instance to effect this transformation. Thus, by a small amount of this body you can convert an indefinite quantity of alumina and silica into this mineral. As much fluoride of silicon finally escapes from the tube as entered it in the first instance. It is one of the most beautiful and striking experiments I know in the whole of this department of science. The staurolite produced in this way is crystallised.



We pass on to a few remarks on another curious and important mineral,—namely, topaz. This is a compound the precise rational composition of which does not appear to be very clearly understood even at the present time. It is essentially a silicate of alumina containing fluorine, but some doubt is entertained as to the exact mode in which that fluorine exists in the compound.

Now, one might have reasonably anticipated that topaz might have been produced in some such way as that I have just explained with regard to the production of staurolite; but, according to Deville, who tried the experiment, topaz cannot be so formed. There is, however, some little discrepancy in the statements which have been made on this point; for Daubrée states that it is formed by heating alumina to redness in a current of fluoride of silicon. We must wait for further information, seeing that these two chemists disagree on the subject. But if topaz cannot be so formed, a peculiar mineral termed "zircon," which is a silicate of zirconia (zirconia corresponding in formula with alumina), may be produced in beautiful crystals when the fluoride of silicon is passed over zirconia. Take a tube containing zirconia, and heat it to a pretty good red heat, or more than that, and then pass over the gas fluoride of silicon, and you obtain the mineral crystallised—a silicate of zirconia. It occurs, Deville says, in octahedral crystals, and these crystals exactly resemble those of Monte Somma in Vesuvius. He assures us that they have the same faces, the same angles, and the same external characteristics; so that he concludes that it is almost certain that they must have resulted from the same process—from the same operation of fire. Every mineralogist knows that certain specific minerals have peculiarities according to the locality, and these must depend upon certain conditions attending their formation. Now, as these crystals of zircon possess such an assemblage of characteristics, I think we may reasonably admit that Deville's conclusion has something like a good foundation to rest upon. Then he further remarks, it may be demonstrated that the small quantities of fluor existing in the metamorphic rocks, or rather beds of this kind, have sufficed to form indefinite quantities of zircon. We shall, by-and-by, direct attention to the subject of fluor, which may have played a very important part in the economy of nature,—a much more important part than many persons are yet disposed to admit. It is, as we shall see, a very widely-diffused element, though occurring only in small quantity.

When the same experiment, to which I alluded, was made entirely with zirconia, instead of alumina, the whole contents of the tube were completely transformed into zircon. Zircon occurs in rocks which, there is reason to believe, have been exposed to a tolerably high temperature. It occurs in the syenite of Norway, for example, replacing felspar; so that the rock consists only of hornblende, zircon, and a small quantity of quartz; hence the rock is designated "zircon-syenite."

The next mineral which it may be interesting to examine is the mineral termed "cryolite," which, in fact, forms a geological bed. It is an exceedingly remarkable mineral. I presented to you a specimen of it at the last lecture, as being a source of aluminium,—a large white lump, fusible at a comparatively low temperature. It is, as I then told you, a compound of fluoride of sodium and fluoride of aluminium. Its formula is $3NaFl + Al_2Fl_3$. It is an anhydrous mineral—that is, free from water. It contains about 13 per cent. of aluminium. It is found in Greenland in a layer in gneiss, and in the vicinity of mica. According to Bischoff, there is a quantity of mica about it which he supposes has played a very important part. The bed of cryolite is eighteen feet thick. Cryolite is associated with various minerals which undoubtedly are of aqueous origin. For example, iron pyrites,—though certainly not prepared at a high temperature—copper pyrites, galena, and sparry iron ore, which certainly never could have occurred at a high temperature,—these are the associates of cryolite, and they tell us the story of its formation. It is clearly produced by the agency of water as a solvent. It may be produced by melting together directly fluoride of aluminium and fluoride of sodium. It may also be formed in the wet way by digesting fluoride of sodium with excess of hydrochloric acid and common gelatinous alumina.

Bischoff supposes mica to have played a very important part as a source of fluorine,—indeed, as a source of fluorine in common fluor spar which we meet with in so many localities.

The next subject for our consideration is one of considerable importance—of the highest importance, I may say. It is that of calcium and lime.

All lime, like alumina, contains a metallic base. Calcium, the base of lime, is exceedingly light, has a yellowish colour, is readily fusible, and exceedingly oxidisable, so that it is impossible to expose it to the air without its undergoing oxidation—contrary to what we have seen is the case with aluminium. I understand that recently some important experiments have been made by Wöhler on the subject. He has discovered certain combinations of carbon and calcium, equivalent to those known in iron—in the form of pig iron.

It is with lime especially, and its compounds, that we have to do. Lime is composed of one equivalent of calcium and one of oxygen. You are all familiar with the properties of lime—an amorphous body, white, or more or less coloured with impurity, and which, on the application of water, slacks; that is, it absorbs water, the water enters into combination with it, and becomes solid, and on its passing from the liquid to the solid state, a large amount of heat is evolved. The lime falls to pieces, having become hydrated, or, in common language, slacked. It is slightly soluble in water, as every one knows, producing the well-known liquid called lime-water. When combined with water—for it must be hydrated—it unites readily with carbonic acid, forming carbonate of lime.

Carbonate of lime is a mineral which occurs very extensively in nature, forming beds of chalk, limestone, and two very important minerals, namely, calcite and arragonite. Carbonate of lime is a compound of one equivalent of carbonic acid and one of lime. It is known in three distinct states. There is, first, the amorphous or chalk-like state. We will call it chalk. It is perfectly non-crystalline, or amorphous. There is, then, the form of arragonite which occurs in prismatic crystals, and belongs to the prismatic system. The third form of carbonate of lime is that of calcite or calcspar, which is rhombohedral, crystallising in the beautiful rhombohedral crystals with which every mineralogist is familiar. Arragonite varies in specific gravity from 2·93 to 3·01. This is a point to note. The calcite has a lower specific gravity, ranging from 2·69 to 2·75, so that not only in their crystalline system, but also in specific gravity, are these two minerals distinguished clearly from each other.

The next point on which I shall speak is the solubility of carbonate of lime. In treating this subject of chemical geology, I am selecting all those points which I conceive have a direct geological bearing; and it is requisite to pay rather close attention, which, perhaps, may be considered tedious, to this part of our subject. One part of carbonate of lime dissolves in 110,000 parts of pure water, in round numbers. It is 110,132 parts really. This carbonate of lime dissolves to a much greater extent when carbonic acid is passed through the water, and it then forms what is termed bicarbonate of lime. One part of carbonate of lime dissolves in 998 parts of water containing carbonic acid, according to Bischoff, the carbonic acid being passed through the water for an hour. He has made several experiments upon this subject, which are remarkable. He finds that the solubility varies to a great extent with the nature of the carbonate of lime operated upon. Thus, 11·15 parts of chalk were dissolved in 10,000 parts of water by passing carbonic acid through for an hour. He performed this experiment three times, and each time he obtained pretty nearly the same result; but, when he tried the experiment with carbonate of lime precipitated from a salt of lime, passing the carbonic acid through for about the same time as he did in the experiments with the chalk, he found that 28 parts dissolved in 10,000 parts of water. There is another very striking statement, but which, I think, will require further corroboration. It is, that burnt muschelkalk dissolved to the extent of 135·3 parts in 10,000 parts of water, by passing carbonic acid through the water for an hour and a-half.

In passing, I will just mention the fact, that when arragonite is exposed to a red heat, it falls to powder; and it was supposed for a long time that this powder consisted of minute rhombs of calcite. This, however, I find denied by Gustave Rose, who contends that the powder is strictly amorphous.

Let us now consider the mode of formation of arragonite, or the conditions under which it may be produced; and, when we understand these conditions, I think we shall find that the information afforded will tend to elucidate the formation of certain geological phenomena, especially with reference to temperature. It will indicate to us the temperature and other conditions under which rocks containing arragonite may have been formed.

Arragonite may be formed by dropping common chloride of calcium in molten carbonate of potash or soda. The method is to melt the carbonate, and then drop in the chloride of calcium. Decomposition occurs, and chloride of potassium or sodium and carbonate of lime are formed. We owe to Gustave Rose several experiments upon this subject, which, though they may seem somewhat minute and tedious, are extremely important and interesting. In the molten state the mass is clear, but it becomes opaque and white on solidification. Upon washing the product with cold water, an amorphous carbonate of lime or chalk, as I may call it, was produced. It was always obtained at first in minute microscopic globules, perfectly amorphous, or non-crystalline; but Rose tells us that after twenty-four hours the whole became changed into rhombic crystals of calcspar. That is a curious point. I must ask your particular attention to the temperature of the water employed, and the degree of dilution, for all depends upon those two conditions. On the other hand, by boiling the product in water, instead of washing it with cold water, the globules are almost instantly changed, not into rhombs of calcspar, but into prisms of arragonite. This little difference of temperature, then, is sufficient to effect this great change. These microscopic crystals of arragonite being left to cool in the water, become transformed into rhombs of calcite. He found that the same results were obtained by substituting chalk, arragonite powder, or calcspar, for chloride of calcium. Some experiments on this subject were made a long time ago by Becquerel, to whom we are deeply indebted for a great variety of experiments bearing on the subject of mineralogy. He was one of the first to take up the subject energetically. He formed arragonite by leaving plates of selenite or gypsum during several years in contact with a solution of bicarbonate of soda of the specific gravity of 1·070. The result of the decomposition was sulphate of soda and carbonate of lime. The carbonate of lime produced appeared in the form of crystallised arragonite. The crystals consisted of very acute double pyramids, base to base, thus producing a very acute dodecahedron. The same result was obtained in a few days by heating to the boiling point (100° C.) plates of selenite in a solution of bicarbonate of soda, saturated cold. The solution was contained in hermetically-sealed tubes of glass, and great pressure was given by a very ingenious artifice. There was no necessity in this case for raising the temperature of the glass very high to get the pressure. The pressure required was about five atmospheres, and this was obtained by half filling the glass with the solution in question, and then putting in a few drops of bisulphide of carbon, which is an exceedingly volatile body. It was inert, having no effect whatever upon the solution, but it enabled him to get a pressure of five atmospheres at this low temperature. He tells us that the crystals of arragonite which he thus formed were very distinct and very limpid, and in ten days they were $\frac{4}{100}$ths of an inch on the side.

I especially commend these various points to your attention. They are apparently very small and trivial, but I think you will admit that in their application they may be of considerable importance, as small things, or what appear to be small things, very often are. Gustave Rose found that, by leaving a very dilute aqueous solution of carbonate of lime in excess of carbonic acid, freely exposed to the air, arragonite was formed. All depends upon the solution being very dilute and at the ordinary temperature. If a common solution of carbonate of lime in excess of carbonic acid is thus left exposed, you will get, not arragonite, but crystals of calcite. That is a remarkable fact. By heating a common solution of carbonate of lime—that is, a solution containing the ordinary amount of carbonate of lime dissolved by virtue of the presence of carbonic acid—you get arragonite, and not calcite. An ordinary solution of carbonate of lime, or—what is equivalent—a much stronger one, gives calcite by exposure at the ordinary temperature; and this same solution, when heated, deposits arragonite. If such a solution be evaporated in a platinum vessel, the residue contains carbonate of lime in all three forms, namely, the amorphous, or chalk, arragonite, and calcspar. That is an important point.

Having obtained these results, Rose then went on to investigate the precise changes corresponding to different degrees of temperature. I will give you his chief results. At 100 centigrade—that is, the boiling point of water—the greatest part of the residue was arragonite in characteristic small prisms. At 90° the most arragonite was formed, and the crystals were larger than at other temperatures. At 70° the rhombic crystals of calcspar predominated, and were accompanied by hexagonal plates and small stars of calcspar, and the arragonite crystals were small. At 50° there was more calcspar, and the proportion of plates and stars as compared with the rhombs of calcspar increased. The arragonite crystals were thicker, and often bent or curved. At 30° no arragonite whatever was formed. The rhombic crystals of calcspar were comparatively large, and there were still some plates and stars. I think that you will agree with me that it was very remarkable that he should get these varieties of deposit under these different degrees of temperature and solution. All the arragonite occurred at a higher temperature than 30°, and the hexagonal plates of calcspar were formed at a lower temperature than 70°. Calcspar is always formed in solutions containing carbonate of lime, when carbonic acid is set free. By exposing in a warm place a well-stoppered vessel containing a concentrated solution of carbonate of lime in excess of carbonic acid, crystals of calcspar were deposited.

Experiments were also made by Rose, with especial regard to the influence of the degree of dilution, and so forth, upon the result. He took two ordinary small flasks—one containing a very dilute solution of carbonate of soda, and the other containing a dilute solution of chloride of calcium; he tied them together, and then immersed them in a cylindrical vessel of water. He left them under the water, and, in consequence of diffusion, a mixture took place with extreme slowness, the chloride of calcium mixing with the carbonate of soda. In this case, the result was the formation of arragonite; and if the solutions were a little stronger, he then got calcspar. The conclusion, therefore, is, that, under special conditions of dilution, arragonite may be formed even at the ordinary temperature.

I am sorry to be obliged to weary you with so much detail, but it really is essential to the right understanding of our subject, and I cannot avoid it.

In native arragonite a little carbonate of strontia is found frequently, but not always. Its maximum amount, taking a goodly number of analyses recorded, I find to be stated at 2½ per cent. It ranges from nothing to 2½ per cent. At one time it was supposed that the carbonate of strontia was a universal and essential constituent of all arragonite, and that this determined its crystalline form. That opinion, however, has been shown to be an error, because we not unfrequently find arragonite free from strontia. A little water is also generally present in arragonite. I find that the extremes given by a number of analyses are 0·17 per cent. and 0·41 per cent. Water is given as a constituent in all of them. Arragonite is deposited from hot springs, as at Carlsbad, where there is a well-known spring, to which I shall have to refer again in connection with the subject of fluor spar. It occurs also in gypsum at Molina, in Arragon, and at Dax, in the Landes. It is also found in basaltic rock, in the serpentine rock in the Valley of St. Nicholas, in Piedmont, in lavas in Vesuvius and Iceland, in beds of brown iron ore at Saalfeld, the Harz, and Styria.

We now come to the mineral calcite, calcspar, or Iceland spar, of which you will see a very magnificent specimen here in the museum. There are some specimens before you very beautifully crystallised. This calcite is pure carbonate of lime. So far as analyses tell us, some specimens of Iceland spar are absolutely chemically pure. Sometimes they contain about one-half per cent. of water, and they not unfrequently enclose foreign matters, such as copper pyrites and sand.

Next as to the formation of calcite. Calcspar, or crystallised carbonate of lime, crystallises in the rhombic system. We have seen that it can be produced by means of water. We will now consider its production through the agency of fire only. We have all heard of the famous experiments of Sir James Hall, the record of which now lies before me. I think they were commenced in 1798, and the results were communicated to the Royal Society of Edinburgh. He informs us that he took amorphous carbonate of lime, or chalk, and by exposing it to a high temperature under considerable pressure he succeeded in converting it into saccharoidal limestone, like Carrara marble. I have had an opportunity of seeing one specimen prepared by Sir James Hall himself, and I must say that the result did not strike me as conclusive. But now for the evidence. He enclosed carbonate of lime in gun barrels, and resorted to various expedients of plugging those gun barrels, such as plugs of soft metal and so forth. He then exposed a portion of the gun barrel to a high temperature, taking care to arrange the tube horizontally in such a manner that the plug of soft metal should not be melted; and he obtained a hard substance like limestone after having exposed chalk to these conditions. He says, "My first application of this scheme was carried on with a common gun barrel cut off at the touch-hole, and welded very strongly at the breech by means of a plug of iron. Into it I introduced the carbonate, previously rammed into a cartridge of paper or pasteboard, in order to protect it from the iron, by which in some former trials the subject of experiment had been contaminated throughout during the action of heat. I then rammed the rest of the barrel full of pounded clay previously baked in a strong heat; and I had the muzzle closed like the breech, by a plug of iron welded upon it in a common forge, the rest of the barrel being kept cold during this operation by means of wet cloths." This gives you an idea of one of his experiments. Then he comes to the use of fusible metal. He employed tubes of glass. I wish particularly to examine the evidence upon this subject, because it is one on which much stress has been laid. I do not wish to question unnecessarily the accuracy of Sir James Hall's conclusions, but I may remark that the carbonate of lime being heated to a high temperature in contact with glass, the result would be altogether vitiated, and the crystallisation could not be said to depend merely upon the outward conditions to which the substance was exposed. We find that in other experiments he used small quantities of carbonate of lime in contact with silica and clay; but the presence of these two bodies would very much modify the result. In other experiments he used borax, and that again would altogether vitiate the result. Therefore, the conclusions drawn from these experiments are unworthy of being received—at all events, without further evidence. He tells us, that in several cases the material which he obtained, although resembling crystalline limestone, fell to pieces on exposure to the air. That, however, is not the property of crystalline limestone. I have no doubt that the investigations of Sir James Hall were conducted with perfect honesty and candour, and they must have involved a great deal of expense; but, as far as I know, recourse was never had to chemical analysis, and, without that, no result ought to be received. Indeed, Sir James Hall himself confesses his deficiency in chemical knowledge. He tells us, that in various experiments he got a product in glass-like drops which were semi-transparent, and this clearly proves that the carbonate of lime operated upon could not have been pure. Having carefully gone over these experiments, I have no hesitation in stating that, as I said just now, I consider them to be unsatisfactory. "By the lens," he says, "this same surface was seen to be glazed all over, though irregularly, showing here and there some air-holes. In fracture it was semi-transparent, more vitreous than crystalline." Last of all, he uses platinum, to obviate the effect of the iron. The effect of the iron would be to act as a strongly reducing agent upon the carbonic acid by the formation of carbonic oxide, and the tendency to decompose the carbonate would of course be facilitated by reasons which are well known to chemists.

It appears, after all, that Sir James Hall obtained some results which would certainly lead us to believe that, by the application of a strong red heat, carbonate of lime would acquire a crystalline structure; but it is exceedingly desirable that these experiments should be repeated with all possible care, that the question may be cleared up satisfactorily. No doubt they would involve considerable expense; but if proper care were taken, and proper apparatus employed, I have no doubt that we should obtain something like very decisive results. I hope that you will not consider that I have shown the smallest disposition to speak disparagingly of the labours of Sir James Hall. I do attach some importance to these investigations, and I think they are in the highest degree creditable, considering the time at which they were made. They extended over several years; but, looking at the results, I cannot feel that confidence which seems to be generally reposed in them. Some years ago, Gustave Rose took up the subject, and came to the conclusion that Sir James Hall had been entirely mistaken; but more recently he has come to an opposite conclusion. But Rose's experiments are by no means so conclusive as they might be. In his recent experiments, which are published only this year, and will be found in the 118th volume of Poggendorf's Annalen, by employing a wrought-iron vessel, electro-plated with nickel, and capable of being closed—so avoiding the contact of iron at a high temperature with the carbonate of lime operated upon, and, consequently, the reducing action of that metal on the carbonic acid of the carbonate of lime—he succeeded in changing arragonite into a substance having the charcteristic appearance of Carrara marble. The experiment, he tells us, was conducted in a Siemen's gas-furnace—that is, a furnace capable of sustaining a long-continued and high temperature. A closed unglazed porcelain vessel was employed, and exposed to a white heat during half an hour, and he informs us, that under these conditions a piece of lithographic stone became greyish-white in fracture, and, under a lens, was found to be finely granular. The product was analysed, and contained,—Lime, 56·61; magnesia, 0·41; carbonic acid, 42·37; residue, 0·45. Pure carbonate of lime contains 56 per cent. of lime and 44 per cent. of carbonic acid. What was the undetermined residue? The presence of a small amount of silica might make a considerable alteration in the result. After carefully examining the way in which Rose's experiment was conducted, it appears to me inconclusive. It is obvious that there could have been no sensible degree of pressure. The porcelain vessel was not in the least injured, so that the temperature must have been much below that which we can now command—as, for instance, in the fusion of platinum. It is most desirable that we should have some further investigation on the subject. The British Association might take up the question with advantage; they have funds at their command, and it would be exceedingly desirable to settle this important point once for all.

What we call carbonate of lime in nature—take even the purest marble—is not pure. At one time I was anxious to investigate this point, and I went to a sculptor and obtained numerous varieties of marble, but in not one of them did I fail to detect alumina. Chalk is an impure body, and the presence of foreign matter might altogether modify the results of experiments made with it. I could show you, for example, a well-known variety of fire-brick, which consists almost entirely of silica. Upon taking hold of it, you will find that it is a hard, solid, enduring brick. You may ask, "How could you get this silica to unite so as to form a hard brick?" For a long time it was kept secret: done by the intermingling of a very small proportion of lime, which caused the formation of one solid brick; and it is very possible that foreign matters might be present, and modify the result of experiments made on the crystallisation of carbonate of lime. We ought to appeal to chemical analysis to inform us what we are doing. It is vain to rely upon experiments where chemical analysis is not brought into use, or we may be led into serious error.

The next question we shall have to consider is, the derivation of lime in nature. What ready source of carbonate of lime is there in nature? According to Bischoff, in his valuable and compendious book on chemical geology, it exists in the so-called Plutonic rocks in combination with silica, forming silicate of lime; and this compound is decomposed by water containing carbonic acid, even when in mechanical suspension in the water. We shall resume this subject in the next lecture.

ACADEMY OF SCIENCES.

January 4, 1864.

THE report of this meeting arrived too late for insertion last week.

A communication by M. BERTHELOT "*On the Proportion of Ethers contained in Brandies and Vinegars*," was read. This was an application of the author's previous researches on the limits of etherification in definite mixtures of alcohol and water. French brandy, as our readers know, contains water, from 40 to 60 per cent. of ordinary alcohol, with traces of amylic and other alcohols, a part of the volatile acids of the wine, such as acetic, butyric, succinic (?), etc., and, lastly, the volatile ethers of the wine, acetic, formic, etc. Some essential oils, aldehydes and other matters, are present, of which the author takes no account. The point to be determined was the limit of the etherification in a brandy which had been kept for several years. This, as M. Berthelot has shown before, will depend on the proportions of the alcohol and water. Thus, in a brandy containing 60 per cent. of alcohol and 40 per cent. of water, and kept for several years, the free acid will represent half the weight of the acids etherified. In a brandy containing equal weights of alcohol and water, the free acid will be four-fifths of the combined acid; and in an old brandy containing only 40 per cent. of alcohol, the free acids represent five-fourths of the combined. The addition of ready-formed neutral ether to brandy to give it a bouquet, occasions, says M. Berthelot, more complicated reactions than is generally supposed. If a quantity in excess of limit which would be formed in the brandy is added, the ether soon begins to decompose, setting free a part of the alcohol and acid of which it was composed. The limits of etherification in vinegars made from wine, have also been determined by M. Berthelot. He gives a formula, but we quote an example:—In a vinegar containing 60 grammes of acetic acid and 1 gramme of alcohol in a litre, the weight of acetic ether formed in course of time will be equal to 0·12 of a gramme.

In a note which follows, M. Berthelot intends to "shut up" M. Maumené on the question of the action of alcohol on wines. M. Berthelot recommends his opponent to take a bottle of good Burgundy, and decant a part of the wine into a clean bottle, shake it well for a quarter-of-an-hour, so as to mix the wine with air, and then to taste, or get some unprejudiced person to taste, this and also the undecanted wine.

M. MAUMENÉ submitted a note "*On the Solubility of Nitrate of Soda.*" As this salt is of considerable industrial importance, we give the author's results in another part.

A note by M. ALLNARD was read, entitled "*Experiments on the Boiling-points of Mixtures of Two Liquids which mutually Dissolve in all Proportions.*" The experiments were made with mixtures of sulphide of carbon and ether, sulphide of carbon and alcohol, and alcohol and water. The results of the experiments are given in tables, for which we have not space. They were undertaken in consequence of the author having discovered that ether mixed with one-tenth of its weight of sulphide of carbon boiled at the same temperature as pure ether. Similar observations were made with other mixtures. It follows, that the boiling-point is not always a test of purity. To determine the purity of a liquid (the author says), recourse must be had to Regnault's process for determining the elastic force of the vapour, employing successively the static and dynamic method. In this way Regnault discovered the presence of $\frac{1}{1000}$th of a substance added to alcohol or to sulphide of carbon. Another conclusion is, that it is sometimes impossible to separate two liquids by fractional distillations when one is in small proportions. This supports the conclusions of M. Berthelot already published.

A note, by M. SCHUTZENBERGER, "*On the Transformation of Coagulated Albumen and Casein into a Soluble Albumen Coagulable by Heat*," was presented. This curious result is obtained by dialysis. The author dissolved pure coagulated albumen in as little potash as possible, and treated the albuminate of potash with an excess of acetic acid. The mixture was then dialysed, and as soon as the inner liquid showed no acid reaction it was examined. At first it was clear, but it soon became opalescent. Heat coagulated the albumen; so did mineral acids, and, strange to say, so did alkalies and neutral salts. This happened also with uncoagulated white of egg, which was acidulated with acetic acid and then dialysed. Solutions of casein in hydrochloric acid, after dialysation, gave similar results. The author correctly says, that these experiments are important in a physiological point of view.

January 11.

M. NICKLÉS communicated some results, curious if true, of his observations on the thallium line in the spectrum. He states, that he has found thallic compounds which do not give the characteristic line. For example, in a mixture with chloride of sodium the yellow colour of the sodium completely paralyses the green line. We shall give the paper at length in an early number. M. Nicklés announces that he has obtained an alum with sesquioxide of iron and thallium, $Fe_2O_3 3SO_3, + TlO.SO_3 + 24HO$, which fuses at 100°, and then loses 22 equivalents of water.

MM. Bechamp and Pasteur continue to send communications on Ferments, and M. Maumené also on the Action of Oxygen on Wine.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. HOFMANN, F.R.S., LL.D., &c., &c.

(NINTH NOTICE.)

(*Continued from page 31.*)

UNDER the head of "Miscellaneous Mineral Products" are classed some of those substances which have been introduced as "cow-dung substitutes" in calico dyeing. The manufacture of these substances now constitutes an important branch of trade, as our readers will see from a statement here made, that the production of one (arsenate of sodium) amounts to not less than ten or twelve tons a-week in South Lancashire alone. Other substances employed for the same purpose are phosphate of lime, with gelatine, silicate of soda, and stannate of soda.

Before we notice these compounds, we may briefly refer to the process. Cow-dung was, and, in some instances, is still used to perfect the mordanting of a cloth before dyeing or printing. The *modus operandi* is difficult to explain, "but," says the Report, "so far as the effects of the cow-dung can be made out, they appear to resolve themselves into the following:—The albuminous and mucilaginous principles present (in the dung) entangle and separate the excess of saline mordant, which, if left mechanically adherent to the cloth, but not chemically fixed thereon, would spread to its imprinted portions, and cause these to take the dye, so as to blur and spoil the pattern. The alkaline quality of the dung both tends, more or less, to neutralise the acid of the mordant, and, by giving it a basic character, to promote its fixation on the fabric. To this fixative effect the calcic phosphates present (in the dung), as also the bitter and resinous principles, are supposed to contribute. It is known that basic salts generally, and basic phosphates in particular, have a powerful attraction for colouring matter; and there is no doubt that the combination of these with the mordants gives superior brightness and fulness to the colours. It is alleged by Mr. Walter Crum, M. Scheurer-Kestner, and other chemists, that the basic oxides of the mordants are liable to assume an allotropic condition, in which their affinity for the colouring matter is lost; and that this change is, in some unexplained manner, prevented by the dunging process."

After this explanation, it will be guessed that one of the first things employed as a substitute for cow-dung was a mixture of phosphate of lime with animal matter—in this case gelatine in place of albumen. Messrs. Mercer, Prince, and Blyth boil calcined bones with dilute sulphuric acid, separate the solution obtained from the sulphate of lime, and then neutralise it with carbonate of soda. The resulting mixture is then evaporated nearly to dryness. The gelatine is added immediately before use, and the mixture may be used either as a bath or as a paste.

Silicate of soda is also extensively used as a cow-dung substitute, and is one of the best; but for this purpose it is necessary to avoid an excess of alkali in the silicate. Mr. Higgin accordingly neutralises with a suitable acid. The silicate acts by fixing the mordant in the form of a basic silicate, producing tints of great stability and beauty.

Arsenate of soda is made by Mr. Higgin by first dissolving arsenious acid in caustic soda, and heating the arsenite so formed with nitrate of soda in a reverberatory furnace. In this way all loss of arsenious acid by volatilisation is avoided, and the whole of the nitrate is converted.

Another plan, by which the arsenate of soda is obtained as a by-product, is to substitute arsenious for sulphuric acid, to liberate nitric acid for the manufacture of sulphuric acid. It is said, however, that sulphuric acid manufactured in this way "is apt to acquire an arsenical impregnation."

Stannate of soda is most often made by fusing tin ore with nitrate of soda. For printing purposes it is generally employed with about 5 per cent. of arsenate of soda.

A beautiful new blue pigment, called ceruleum, and introduced a few years ago by Messrs. Rowney and Co., is next noticed. It is essentially a stannate of cobalt, but mixed with stannic acid, sulphate of lime, and silica. An analysis by Bleekrode showed it to contain—

Peroxide of tin	49·66
Protoxide of cobalt	18·66
Sulphate of lime and silica	31·68
	100·00

This compound is of peculiar value, as it retains its tint in artificial light. It does not change, moreover, in contact with air.

There is also a pink colour, into the composition of which binoxide of tin enters largely. "The mode of preparation is as follows:—To a mixture of binoxide of tin, chalk, and quartz sand, there is added about $\frac{1}{40}$th part by weight of chromate of potash. This is dried, pulverised, and calcined in a crucible at an intense red heat. After cooling, the fritted mass is pulverised, and the powder again calcined. It is then only necessary to pulverise for the last time, and to wash and dry the product." This colour has been exclusively used for painting on porcelain, but is also, the Report says, applicable in oil and water-colour painting.

The notices of sulphate of iron and copper salts offer nothing of novelty for extraction.

The next section of the Report is occupied with *Disinfectants;* but, although of great interest, we must dismiss the subject very briefly. Disinfectants are here classed under three heads—the *fixative*, the *antiseptic*, and the *oxidising*.

The *fixative* (*e.g.*, salts of iron, lead, zinc, and copper) act by entering into combination with the volatile products of putrefaction.

The *antiseptic* (*e.g.*, carbolic acid) have the property of arresting the decomposition.

The *oxidising* (*e.g.*, chlorine, sulphurous, and nitrous acids, porous bodies, charcoal, and permanganates) change the character of the decomposition, and render the volatile products comparatively innocuous by assimilating them in character to the products of decay. Much and deserved praise is given to the charcoal air-filters of Dr. Stenhouse, and permanganates of Mr. Condy, both of which, however, are too well known to our readers to call for remark here.

The Reporter next comes to the organic products exhibited.

De Spectraal-Analyse. Akademisch Proefschrift, &c., ter verkrijging van den grad von Doctor in de Wis-en Natuurkunde, aan de Hoogeschool te Utrecht, door HENDRIK CORNELIUS DIBBITS. Rotterdam: E. H. Tassemeijer. 1863.

IT is much to be regretted that this work is written in a language not ordinarily read by scientific men. It is far above the common run of theses for a degree, being, in fact, a complete treatise on spectrum analysis. The historical review is particularly interesting and valuable, the author doing full justice to the discoveries of Wollaston, Miller, Daniel, Herschel, Brewster, and Talbot. Not the least useful part of the introduction is a very carefully compiled bibliography of spectrum analysis. A good account of all the spectra hitherto observed follows, and at the end are some beautifully-executed coloured drawings of various spectra.

Spectropia; or Surprising Spectral Illusions, showing Ghosts everywhere and of every colour. By J. H. BROWN. London: Griffith and Farran. 1863.

THIS is a clever book: the illusions are founded on true scientific principles, which are clearly explained in a well-written introduction. The drawings of the illustrations are exceedingly well executed; but there is too much of the hideous. If ghosts are to be common, their appearance must be made agreeable.

NOTICES OF PATENTS.

2462. *Apparatus to be used in the Manufacture of Sulphuric Acid.* S. PUDNEY, Clapham, Surrey. Dated September 6, 1862.

IN the construction of the chambers ordinarily used for the manufacture of vitriol, the inventor proposes to introduce glass in partial replacement of sheet lead. It is preferred to use a foundation of lead in the form of a shallow cistern of that metal, and then to erect an enclosed superstructure made of sheets of glass connected together by means of ribs and strips of lead.

2483. *Manufacture of Copper from Copper Ores.* J. Fleitmann, Iserlotur, Prussia. Dated September 9, 1862 (Not proceeded with.)

For the treatment of copper ores which contain arsenic, antimony, and phosphorus as impurities, the inventor proceeds, in the first instance, to roast them in the usual manner, and to separate, by known processes, any silver or gold that may be present. Having obtained a copper regulus, contaminated only with the elements above mentioned, it is ground to powder and roasted "dead," and the crude oxide thus obtained is moistened with the solution of a caustic or carbonated alkali, dried, and again exposed to heat, avoiding the use of a degree of temperature which would be sufficient to fuse the oxide of copper, but at the same time high enough to melt the alkali. This process is said to remove the metallic impurities, and, by afterwards washing with water, and reducing the oxide of copper, either by carbon alone, or by that element conointly with hydrogen, a refined metal of good quality is obtained.

2491. *Extracting the Liquid Portion of Yeast, Spent Hops, &c.* G. Ritchie, Edinburgh. Dated September 10, 1862.

This operation is conducted for the purpose of economising the liquid which is ordinarily retained in the husk or refuse of grains, spent hops, etc., and is effected by the use of a filtering apparatus connected with an air-pump, so that the pressure of the atmosphere may be made available for the separation or extraction of the last portions of liquid from the solid matters.

2508. *Manufacture of a Double Sulphide of Calcium and Sodium.* P. Ward, Bristol. Dated September 11, 1862.

According to this invention, the patentee takes the oxysulphide of calcium (alkali waste), and mixes it in a fresh state with sulphate of soda, so as to produce, by double decomposition, the sulphate of lime and the soluble salt named in the title. The application of heat hastens the conversion, and the relative proportions to be employed depend upon the exact composition of the materials, which vary between certain limits.

2554. *Apparatus for the Manufacture of Gas from Petroleum Oil and Water, or from Cannel Coals, Bituminous Coals, Schists, Tar, Crude Coal Oil, or other Hydrocarbons and Water.* G. Haseltine, Fleet Street, London. A communication. Dated September 17, 1862. (Not proceeded with.)

This invention relates to the construction of a retort composed of three chambers, so as to admit of the introduction of water in its spheroidal state into the lowest chamber of the retort, which is kept at a very high temperature, and in such a manner that the intensely-heated steam may come in contact with the vapour of hydrocarbons simultaneously admitted. As the result of this mode of proceeding, it is said that no carbon is deposited from the naphtha or oils during the generation of the gas, and, consequently, that the maximum illuminating power is obtained. The principle of this scheme is somewhat similar to that involved in the manufacture of gas according to the terms of the specification No. 2458.

2556. *Improvements in Obtaining Hyponitric Acid and Nitric Acid from Nitrate of Soda.* L. Mond, Hesse Cassel, Germany. Dated September 18, 1862. (Not proceeded with.)

For effecting the decomposition of nitrate of soda, it is to be heated in contact with an indifferent metallic oxide, particularly one of the following:—Peroxide of iron, magnetic oxide of iron, protosesquioxide of manganese, the corresponding oxide of cobalt, protoxide of nickel, or oxide of copper. By heating such mixed materials to redness in iron or clay retorts, and conducting the gases into water, a certain quantity of nitric acid is directly obtained, whilst the lower oxides of nitrogen and evolved oxygen may be made available in the production of sulphuric acid. The residue in the retort consists of caustic soda and the unaltered metallic oxide, so that water will extract the alkali, and leave the latter in a state fit for repeated employment.

Mr. Webster claims the heating of nitrate of soda with peroxide of iron or oxide of zinc as a means of preparing simultaneously oxygen gas, caustic soda, and nitrous acid. Professor Wöhler has long since described the reactions by which pure caustic soda and potash may be prepared from their respective nitrates by heating with the black oxide of copper.

2565. *Improvements in the Treatment of Sulphuret of Antimony, and in Obtaining Products therefrom.* W. Glass, Princes Street, Stamford Street, London. Dated September 19, 1862.

This invention refers to the preparation of a sublimed white oxide of antimony from the sulphuretted ores of that metal, with the object of obtaining a pigment of great density which answers some of the purposes of white lead. The native sulphide of antimony, with or without the addition of sulphur or antimony, is heated in a reverberatory furnace with a strong air-blast directed upon its surface, so as to oxidise the two constituents of the ore, and give rise, on the one hand, to the production of sulphurous acid, which may be economised in the manufacture of vitriol or in any other way that may be desirable, whilst the oxide of antimony, which sublimes at the same time, is collected in a long flue or chamber in direct communication with the furnace. The residue left on the hearth of the furnace may be treated for commercial antimony, or be refined for gold, silver, or other metals.

This patent is an improvement upon a similar claim, a patent for which has been already granted in the joint names of G. Hallett and J. Stenhouse.

Grants of Provisional Protection for Six Months.

2230. Thomas Brown Jordon, Milton Cottage, South Lambeth, Surrey, "Improvements in granulating and drying gunpowder, and in apparatus to be used therefor."—Petition recorded September 10, 1863.

2892. Edward Chambers Nicholson, Fenchurch Street, London, "Improvements in the manufacture of colouring matters, suitable for dyeing and printing."—Petition recorded November 18, 1863.

3029. Henry Holdrege, Irvington, New York, U.S., "Improvements in the process and manner of making gas for illuminating, heating, and other purposes, a part of which may also be applied to the production of metallic oxides."—A communication from William Henry Gwynne, New York, U.S.

3030. Sanders Trotman, Albert Street, Camden Town, London, "Improvements in the manufacture of soap."

3063. James Alfred Wanklyn, London Institution, Finsbury, London, "Improvements in the production and manufacture of certain yellow and orange colours."—A communication from Eugene Lucius, Hoechst-on-the-Main, Germany.—Petitions recorded December 5, 1863.

3107. Thomas Vaughan Morgan, Battersea Works, Surrey, "Improvements in the treatment and purification of plumbago for the manufacture of crucibles and other fireproof articles, and in apparatus employed therein."

3045. Edward Joseph Hughes, Manchester, "Improvements in the processes of producing aniline black on cotton fabrics or yarns."—A communication from Honoré Cordillot, Dornach, near Mulhouse, France.

3167. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in grinding and polishing glass, and in the machinery or apparatus employed therein."—A communication from James Dodge, Waterford, Saratoga, New York, U.S.—Petitions recorded December 15, 1863.

3183. Charles Humfrey, Suffolk Grove, Southwark, Surrey, "Improvements in dissolving india-rubber."—Petitions recorded December 16, 1863.

2899. Anthony Gapper Southby, Bulford, Wiltshire, "Improvements in stills or retorts for the distillation of petroleum or tars from coal or shale, or the products thereof."

3155. Samuel Smith and Thomas Smith, Fell Street, London, "Improvements in means or apparatus for the manufacture of lozenges."—Petition recorded December 14, 1863.

3207. George Haseltine, Southampton Buildings, Chancery Lane, London, "An improved oil, more especially designed for mixing paints and colours, and a new mode of manufacturing the same."—A communication from Adolph Millochau, New York, U.S.

3046. John Robbins, Oxford Street, London, "Improved methods of obtaining oxygen gas."

Notices to Proceed.

1978. John Thomson King, Liverpool, "Improvements in apparatus for containing and distributing gas for lighting railway-carriages, steamboats, and other movable vehicles and vessels, railway-stations, and other places, parts of such apparatus being suitable for governing the supply of gas and air for various purposes."

1992. Robert Stirling Newhall, Gateshead, Durham, "An improved mode of, and apparatus for, drying chemical compounds and other substances."

2035. Augustus William Parker, Bristol Soap Works, Lewin's Mead, Bristol, "Improvements in the manufacture of soap."—Petitions recorded August 15, 1863.

2078. Richard Archibald Brooman, Fleet Street, London, "Improvements in expressing and filtering oils from seeds and liquids, from other substances containing the same, and in apparatus employed therein."—A communication from Guillaume Cregut and Tschiffeli Brothers, Marseilles, France.—Petition recorded August 21, 1863.

2086. Richard Archibald Brooman, Fleet Street, London, "A new metallic alloy."—A communication from Henry Micolon, Paris.—Petitions recorded August 22, 1863.

2122. George Davies, Serle Street, Lincoln's Inn, London, "Improvements in the manufacture of iron and steel from the cinders and refuse of puddling and other furnaces, and from certain kinds of ores."—A communication from Antoine Leonard Fleury, Philadelphia, Pennsylvania, U.S.

2222. William Clark, Chancery Lane, London, "Improvements in the means of utilising refuse azoted matters of commerce, for the manufacture of various chemical products."—A communication from Amédée Gélis and Lucien Dusart, Boulevart St. Martin, Paris.—Petition recorded September 9, 1863.

2315. Thomas Richardson, Newcastle-upon-Tyne, John James Lundy, Leith, and Robert Irvine, Magdalen Chemical Works, Midlothian, N.B., "Improvements in the extraction or manufacture of oils from vegetable substances."—Petition recorded September 19, 1863.

2146. Henry Edward Kramer, Leipsic, Saxony, "Improvements in printing in colours, pictures, or devices to be used in ornamenting porcelain, stoneware, or earthenware, or any other substances where the colours can be annealed, or melted, or burnt in."—Petition recorded August 31, 1863.

2164. George Whiffen Ewens, Sherborne Lodge, Doris Street East, Kennington Cross, Surrey, "Improvements in the manufacture of wadding, paper, and felted fabrics, and in the preparation of vegetable fibres to be used in such manufactures."—Petition recorded September 1, 1863.

2739. Richard Smith, Glasgow, Lanarkshire, N.B., "Improvements in preparing or obtaining colouring matters."—Petition recorded November 5, 1863.

MISCELLANEOUS.

A Pharmaceutical Bill.—It is stated, in last Sunday's *Observer*, that the Pharmaceutical Society has prepared a bill to compel the registration and examination of all chemists and druggists, which will be presented to Parliament as soon as it meets. We presume our contemporary is misinformed, but it may not be so.

Royal Institution.—Tuesday, January 26, three o'clock, Professor Tyndall, "On Optics." Thursday, January 28, three o'clock, Professor Tyndall, "On Optics." Friday, January 29, eight o'clock, Professor Frankland, "On the Glacial Epoch." Saturday, January 30, three o'clock, John Lubbock, Esq., F.R.S., "On the Antiquity of Man."

Preservation of Animal Substances.—System La Peyrouse.—In reply to some observations made on M. La Peyrouse's patent, the patentee has forwarded to us a pamphlet, from which it appears that the patent has been completed and the process has been in use now for more than two years. The complete success of the method as applied to various animal matters imported from long distances is certified by many scientific and commercial men both in France and this country.

Matches without Phosphorus.—M. Achleitner gives the following mixture as promising all the qualities necessary for producing excellent matches:—

Chlorate of potash	90 parts.
Sulphide of antimony . . .	60 ,,
Silica	30 ,,
Nitrate of lead	25 ,,
Gum arabic	10 ,,
Olibanum	2 ,,

First mix the silica with the chlorate of potash (finely powdered), and the gum dissolved in a little water; then add the nitrate of lead and the sulphide of antimony.

To make Muslin Glass.—Stretch out a piece of tulle or muslin of the required size, and apply to it some fatty body by means of a roller; then place it on a well-cleaned plate of glass, and afterwards remove it very carefully. The glass will be found to retain the impression of the fatty body. It must now be exposed for four or five minutes to the vapour of hydrofluoric acid, after which the network will appear polished upon a dull ground.

To Distinguish Artificially-Coloured Wines.—Blume gives the following simple test:—Saturate a piece of bread crumb with the wine to be tested, and place it in a plate full of water. If the wine is artificially coloured, the water very soon becomes coloured reddish violet, but if the colouring matter is natural, the water, after a quarter or half an hour, is but very little coloured, and a slight opalescence only is perceptible. The test depends upon the difficult solubility of the real colouring matters of wine in water free from tartaric acid.—*Elsner's Chem. Techn., Mittheilhungen*, 1862-1863.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

S. V.—King's College, Evening Classes.

M. P. S.—The Pharmacopœia will appear on the 26th of this month. Copies can then be obtained from any bookseller.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Studies on Copper, by MM. E. Millon *and* A. Commaille.

Sulphites of Copper.—The composition of these salts, studied and discussed by so many chemists, seems to be decided by M. Péan de Saint-Gilles. By directing a current of sulphurous acid gas into a solution of acetate of binoxide of copper, a yellow precipitate is formed, which redissoves in the liquid; but, on boiling the solution, an abundant deposit of small red crystals takes place. M. Péan gives the composition of these crystals as $Cu_3O_2,2SO_2,2HO$. The total amount of copper and sulphur contained in these red crystals accords with this formula; but, by separately estimating the copper in the state of protoxide and binoxide, it will be found that the proportion Cu_2 is too small by 2 per cent., and Cu too large by 3 per cent. Moreover, it is found that the salt contains just 3 per cent. of sulphuric acid mixed with sulphurous acid.

The exact analysis of this combination indicates 6 per cent. of sulphate of binoxide interposed in the salt described by M. Péan; washing removes none of the sulphate before decomposing the sulphite itself. Sulphate of binoxide seems to be constantly present—a fact we have verified by uniformly obtaining the same figures in three successive preparations of red sulphite. This can, however, be avoided by altering the mode of operation adopted by M. Péan and by MM. Chevreul, Bottinger, Dœpping, and Rammelsberg, who examined this salt before he did. The formula of this compound, obtained free from all mixture, and irreproachably pure, is $Cu_3O_2,2SO_2,2HO$, or $Cu_2O,SO_2 + CuO,SO_2 + 2HO$.

It offers the rather curious analytical peculiarity of furnishing the same numbers in binoxide of copper and in sulphuric acid, whether it is pure or mixed with 6 per cent. of sulphate of binoxide.

The yellow deposit formed by sulphurous acid in a solution of acetate of binoxide of copper, M. Péan considers as a peculiar hydrate of the above salt; he assigns to it the formula $Cu_3O_2,2SO_2,5HO$.

The whole determination of copper made by M. Péan agrees exactly with the preceding formula; but by estimating the relative proportion of Cu_2 and Cu, there appears irreconcilable deviations from this formula, and much more decided than in the analysis of red sulphite.

We have obtained, in various preparations, 7·60, 11·66 and 19.72 per cent. of copper in the state of protosalts; the formula adopted by M. Péan would require 28·78 of copper in the state of protoxide. Notwithstanding the above-mentioned variations in the constitution of this compound, the total estimation of copper always gives the same number, precisely that indicated by M. Péan. Thus, this yellow product represents a mixture in which the weight of copper is a fixed quantity, while the degree of oxygenation of the metal varies enormously.

It is probable that sulphurous acid and acetate of binoxide of copper first form an insoluble and unstable sulphate of binoxide, the molecules of which react on each other, the sulphurous acid oxidising at the expense of the binoxide of copper, until the appearance of the red sulphite, producing a new state of equilibrium among the elements.

We have made several attempts to combine sulphurous acid with binoxide of copper, and succeeded by saturating absolute alcohol with sulphurous gas, and adding hydrate of binoxide of copper. A green powder is the result, insoluble in water, resisting lixiviation, and formed exclusively of sulphurous acid, water, and binoxide of copper.

In this salt, binoxide of copper is quadri-atomic, even when a large excess of alcohol, saturated with sulphurous acid, is used. The formula of this new combination is $SO_2,4CuO,7HO$.

This constitutes a new example to add to those combinations wherein salts with polyatomic oxides are formed, in spite of the presence of an excess of acid.

Ammoniacal Protochloride of Copper and Bichloride of Platinum.—The well-defined reaction of ammoniacal protochloride of copper on salts of silver, which are reduced and give a weight of metallic silver exactly proportionate to the quantity of protosalt of copper, has led us to examine the affinity existing between the protochloride of ammoniacal copper and the bichloride of platinum.

The platinum of the bichloride is not reduced to the metallic state, but is simply brought back to protochloride; however large the excess of protosalt of copper, the reduction proceeds no further. It does not thence follow that the affinity of chlorine is greater for platinum than for silver. There is here a special influence, which must be attributed to the intensity of the combinations formed between protochloride of platinum with ammonia,—combinations whose constitution and nature M. Reiset has so ably explained.

This is what takes place:—On pouring a concentrated solution of bichloride of platinum into a very ammoniacal liquid saturated with protochloride of copper, a violet crystalline precipitate is formed, sometimes of a perfectly pure colour, somewhat like the beautiful tints of some cobaltic salts, sometimes with the colour verging on grey, in which case the crystals are smaller, and always in the form of long prisms with square ends, isolated or irregularly grouped, and often scooped out with two conical cavities approaching at their points.

These crystals, very stable when dry, are insoluble in water or alcohol, and alter only at length by washing; their composition is exactly represented by—

$$\left[\frac{Pt,Cu}{2}\right] Cl,NH_3.$$

Their formula may be doubled, and they may be considered as the combination of an ammoniacal bichloride of copper, $CuCl,NH_3$, described by R. Kane; with Magnus' chloride, $PtCl,NH_3$. But it is more probable that this combination represents the chloride of a base, containing two metals, analogous to the unimetallic bases described by M. J. Reiset; but it differs from the latter in containing both copper and platinum, whose reactions are equally masked. This is, we believe, the first instance of a bimetallic ammoniacal chloride. The reactions of this new compound, both with acids and bases, hardly admit of any other supposition.

We shall have to describe several interesting compounds derived from it; but this would lead us away from the study of copper itself, to which for the present we wish to restrict ourselves.—*Comptes-Rendus*, lvii., 820, 63.

Copper Bronze for Paper Hangings.—Boil ten pounds of logwood twice in water, filter the decoction and evaporate to half its bulk. Then add twenty ounces of tin salt. A precipitate falls, which is separated, washed, and dried. The precipitate has then a dark blue colour, and when mixed with soap-suds, spread on paper, and well rubbed, it gives a brilliant metallic lustre. Alum, or bichromate of potash, may be used instead of the chloride of tin.—*Deutsche Industrie-Zeitung.*

On the Supposed Nature of Air prior to the Discovery of Oxygen, by George F. Rodwell, *F.C.S.*

(Continued from page 28.)

5. Boyle's Experiments continued.—*Experiment* 17.[*] A tube three feet long and a quarter of an inch in diameter, closed at one end, was filled with mercury, and inverted in a vessel of the same metal; the latter was placed within the air-pump receiver, and the tube passed air-tight through its cover; on exhausting, the mercury fell nearly to a level with that in the vessel; but the same level within and without the tube could never be attained, because, when the exhaustion was carried on for some length of time, air leaked into the receiver in spite of every precaution. When a quart receiver was used, the first downward stroke of the piston withdrew sufficient air to cause the column to fall eighteen and a-half inches. The falling of the mercury was not, however, entirely due to the removal of pressure, because a minute quantity of air was always present in the space above the mercury, and by its expansion the mercury column would be depressed. The mercury was never boiled in the tube in these early experiments, hence there was always a small amount of air, which was mechanically retained by the mercury, and rose into the so-called vacuum, when the tube was inverted. Boyle states that, when the tube was inclined, the mercury never reached quite to the top of it, and when a hot iron was held near that part of the tube above the mercury, a slight depression of the column was apparent.

Experiment 18. The height of the mercury column in Torricelli's tube was found to vary from day to day, and it did not vary in conformity with the weather-glass.[†] According to Boyle the variation may be caused by ebbings and flowings in the atmosphere, and by sudden changes in its height and density, produced by causes with which we are unacquainted. That changes do take place, he considers is proved by the fact, that the refracting power of the air varies; and miners had related to him that a certain steam, called by them a "damp,"[‡] sometimes arises within mines, and possesses such "thickness" that it extinguishes candles; it may also happen, he says, that fumes ascend from the earth with such rapidity, that the air through which they pass is dragged upwards by them, and a consequent diminution of pressure on that part of the earth beneath the ascending currents, takes place.

Mr. Wren, being asked by Boyle to mention any experiment relative to the pressure of the air which he would wish to be tried, said it would be of importance to observe if the height of the mercury column varied according to the tides, inasmuch as, if it did not do so, Des Cartes' theory, that tides are produced by the increased pressure communicated to the air by the moon at certain times of the day than at others, would be disproved. Boyle did not find the height of the column affected by the state of the tides.

Experiment 19. Having observed, in experiment 17, to what extent a column of mercury could be made to fall on the removal of pressure, Boyle next tried the same experiment with a column of water, contained in a tube four feet long. On exhausting, the water fell to within a foot of the surface of water in the vessel into which the open end of the tube dipped. When air was re-admitted into the receiver, water was driven violently to the top of the tube.

In the 21st experiment Boyle declares he will not say for certain "whether or no air be a primogenial body," incapable of conversion into water; for, although many have affirmed that when water is heated it becomes air, he has observed in chemical distillations that the vapour of water quickly returns to water; and, in the Musæum Kircherianum, Schottus states there is a hermetically sealed glass vessel half full of water, which had been sealed for fifty years, without the water becoming air. On the other hand, however, it appears that air can be produced, because, when a number of iron nails were placed in a mixture of oil of vitriol and water, Boyle found that a quantity of air was evolved, and, although this does not prove that water may become air, it proves, he considers, that air may be generated.

If, by any chance, Boyle had brought a candle near his newly-generated air, what a wide field would have been opened to him when he found that there were other airs differing from "the air;" but the possibility of there being different kinds of air does not seem to have entered his head; for even carbonic acid gas, although so totally different from ordinary air, was only distinguished by him as "thickened air."

Experiment 27. A watch was suspended by a thread in the air-pump receiver; on exhausting, the ticking ceased to be heard; but when air was re-admitted, it was heard as distinctly as before exhaustion.

A bell was supported in the receiver by a bent stick, the ends of which pressed against the sides of the receiver; when the latter was exhausted, and the bell rung, the sound was distinctly audible; hence Boyle concluded that sound can be conveyed by some rarer medium than air.

This is one of many examples of the great disadvantages under which the early experimenters laboured, and we must make every allowance for the false conclusions at which they sometimes arrived. When Boyle made this experiment, very little was known about the nature of sound; there were no previous experiments to tell him that the thread would not convey the vibrations to the receiver, whereas the stick would do so, and he, therefore, could have no reason for believing that there would be any difference in the result obtained, whether he suspended his sounding body by a thread or by a piece of wood, and yet perfectly contrary effects were produced, and he was thus led to a wrong conclusion.

Experiment 33 was made with a view of determining the pressure of air on a known area. The air-pump receiver was removed from the pump, and the piston forced to the top of the cylinder, the upper orifice of the latter (into which the shank of the stop-cock of the receiver fitted) being left open; weights were attached to the piston until it was drawn down. The piston was then forced to the top of the cylinder—the upper orifice of the latter closed—and weights were again attached until the piston was drawn down; the weights obviously represent the force necessary to overcome the pressure of the air, acting on the area of the piston + the force necessary to overcome the friction between the piston and pump barrel; the weight necessary to overcome the latter source of resistance having been previously determined, it was subtracted from the total weight, and it was thus found that 112 lbs. were competent to overcome the pressure of the air on the piston. The experi-

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[*] This experiment, as mentioned in the third of these papers, was tried by a different but far more complete method by Pascal; we must bear in mind, however, that his treatise "On the Weight of the Mass of Air" was not published till 1663, whereas Boyle's "Physico-Mechanical Experiments" appeared in 1661. Pascal undoubtedly made the experiment first, but Boyle was probably unaware of the fact.

[†] An account of some experiments made with the weather-glass here referred to will be given in the next Number of this Journal.

[‡] From the German "dampf,"—vapour, steam, fume.

ment was modified by drawing the piston to the bottom of the cylinder, against the pressure of the air, and seeing how much weight it would draw up—105 lbs. + the weight of the piston rod were raised.[§]

Experiment 34. Reasoning by analogy from the fact that two bodies of equal weight in air, but of different bulk, when weighed in water no longer balance each other, Boyle conceived that two bodies of equal weight in air would not be so in a vacuum. He, therefore, balanced on the opposite ends of a balance, capable of turning with $\frac{1}{32}$nd of a grain, a piece of cork and a piece of lead; the balance was placed in the air-pump receiver: on exhausting, the cork was found to preponderate, but on readmitting air, it continued to preponderate from some cause which Boyle was unable to discover.

Experiment 36. It is obvious, Boyle writes, that if we could place a balance above the atmosphere, or in a vacuum, we might weigh a quantity of air in the scales of the balance, just as we weigh substances in the air. In order to put this idea in practice, he procured a small "glass bubble," about the size of a hen's egg, and sealed it hermetically. It was then fastened to one end of the beam of the balance used in experiment 34, and was counterpoised by a piece of lead. The balance was placed in the receiver; on exhausting, the vessel of air greatly preponderated, and by placing weights on the other scale of the balance, so as to drag down the air-vessel, it was found that, in a vacuum, the air in the bubble weighed $\frac{3}{4}$ths of a grain. On one occasion, when the exhaustion had been continued for some time, the included air burst the bubble with violence.

Boyle here describes several experiments which he made in order to determine the relative weights of air and water. The determination had been previously made by several different methods. Galileo found water to be 400 times heavier than air; Ricciolus (by weighing a bladder of air in air),[‖] 10,000 times; and Merseunus, 1356 times. Boyle's method was to heat a copper elopile of known weight to redness, stop up the orifice with wax, weigh, perforate the wax to allow air to enter, and again weigh; the elopile was then filled with water, and weighed. By this method water was found to be 938 times heavier than air.

Boyle next determined the relative weights of water and mercury, and found the latter to be $13\frac{92}{121}$ times heavier than the former. The relative weights of air and mercury were deduced from the above data, and were found to be as 14000 to 1. When in possession of these facts, Boyle was able to calculate that the height of the whole atmosphere, if we suppose it to possess throughout the same density as at the surface of the earth, would be seven miles; but, he writes, knowing as we do how readily air expands when pressure is removed from it, it is not improbable that the atmosphere may extend to a height of some hundreds of miles.

Experiment 37. Boyle frequently observed that when exhaustion was commenced the inside of the air-pump receiver became opaque, and that on the readmission of air the opacity disappeared. We now know this phenomenon to be produced by the deposit of minute particles of water, previously existing in the state of vapour in the air. The air in expanding performs work, and a certain amount of molecular motion is converted into mass motion; consequently, the aqueous vapour in the air is condensed. When air is readmitted, the particles strike against the sides of the receiver, and the amount of mass motion previously produced is reconverted into the molecular motion which produced it; consequently, the deposited water again becomes vapour.

Experiment 40. In order to see whether the rarity of the air in an exhausted receiver would prevent insects from flying, Boyle placed a bee and a fly in the receiver on exhausting, they both fell down "as in a swoon."

Experiment 41. A lark was placed in the receiver; on exhausting, it was seized with convulsions, and although air was quickly readmitted, it failed to revive. The pump had been worked ten minutes.

I have mentioned in the previous paper that the descriptions which Boyle gives of his experiments are exceedingly prolix; we have a good example before us in this experiment, which we should, in the present day, describe as above, but which Boyle, after telling us how he procured the bird, and how, when placed in the receiver, it did "divers times spring up in it to a good height," describes as follows:—

"The vessel being hastily, but carefully clos'd, the Pump was diligently ply'd, and the Bird for awhile appear'd lively enough; but upon a greater exsuction of the Air, she began manifestly to droop, and appear sick, and very soon after was taken with as violent and irregular convulsions as are wont to be observ'd in Poultry when their heads are wrung off. For the Bird threw herself over and over two or three times, and dyed with her Breast upward, her Head downwards, and her Neck awry. And though upon the appearing of these convulsions we turn'd the stopcock, and let in the air upon her, yet it came too late; whereupon, casting our eyes upon one of those accurate Dyals that go with a Pendulum, and were of late ingeniously invented by the noble and Learned Hugenius, we found that the whole Tragedy had been concluded within ten minutes of an hour, part of which time had been imploy'd in cementing the cover to the Receiver."

We must certainly give Boyle credit for being an accurate observer, and an experimenter who did not pass over the most minute occurrences without mention; but conceive what a memoir would be in the present day if it were spun out like the above account of one experiment! Why, the Royal Society would have to publish folios, and the *Philosophical Magazine* would become a thick quarto, and it would require half a lifetime to master one branch of science.

After the success of the lark experiment, Boyle placed a sparrow and a mouse in the receiver. On exhausting, they both died. In order to see whether death was produced by the "steams" from the lungs stifling the animals or from want of air, a mouse was enclosed in a large receiver. At the end of several hours it was alive and well, but died when the receiver was exhausted, proving that want of air was the cause which had produced the previous deaths.

Boyle here enters into a discussion as to the nature of Respiration. Many of the philosophers of his time believed that the sole use of respiration was the cooling and tempering the heat of the heart and blood; and this theory was not only admitted by several of the ancient writers, but by the Cartesians and numberless learned men. But, Boyle answers, fishes and frogs, and "divers cold creatures," have need of respiration; and in the above-mentioned experiments, in which animals were killed in rarefied air, it did not appear that the interior of the receiver was hotter than the external air.

Some believed that air passes from the lungs to the

[§] The diameter of the piston was three inches; hence its area = 7·0686 square inches. The pressure of the air upon it would, therefore, be, in round numbers, 7·0686 × 15 lbs. = 106·020 lbs.

[‖] It is obvious, as mentioned in the first of these papers (CHEMICAL NEWS, vol. viii., p. 115), that a bladder of air, weighed in air, weighs no more than the empty bladder.

left ventricle of the heart, both to reduce its heat and "to generate spirits." Mæbius and Gassendus believed that the real use of the air in respiration is to ventilate the blood in its passage through the lungs, in which passage impure vapours are given off by the blood, and are removed by the air.

According to Boyle, the use of air in respiration may be explained by two methods; for, first, just as a flame is stifled when burnt for some time in a close vessel by the "fuligenous steams" which it generates, so the vital fire of the heart may require fresh air to prevent it from being extinguished; or the air in the lungs may admit into its pores the impure vapours of the blood and remove them from the lungs. "We know," he continues, "that air too much thickened is unfit for respiration, because in the lead mines of Devonshire 'damps' sometimes arise which extinguish candles and suffocate the miners. Also, in cellars in which a large quantity of new wine is set to work, men have been suffocated on account of the great thickness of the air."

That the air is "thickened" by respiration Boyle proved by enclosing a bird in a small closed vessel. After three-quarters of an hour the air was found to be unfit to support life; and we can quite understand that the air must be thickened, he says, if we admit, with Sanctorius, that the quantity of matter which leaves our bodies by "insensible transpiration" exceeds in weight everything else which is given off from the body.

Air too much "thinned" is also unfit for respiration, as was proved by the death of the animals in an exhausted receiver; and Acosta states that he found some difficulty in breathing on the summit of a very lofty mountain in Peru.

Although Boyle is inclined to believe that one of the uses of air in respiration is to purify the blood, by removing the vapours which it throws off during its passage through the lungs, yet he conceives that it plays some other part; and Paracelsus ¶ had a similar idea, for he affirms that just as the stomach assimilates a certain amount of the meat we eat, and rejects the remainder, "*so the lungs consume part of the air, and proscribe the rest.*"

Cornelius Drebbel, ** also believed that only a certain portion of the air is consumed in the lungs, and it was reported that he had actually discovered that portion. It had been confidently stated to Boyle that Drebbel constructed a vessel for James I. capable of carrying twelve rowers and several passengers beneath the surface of water, and that, so soon as it was apparent that the air in the vessel had become impure from respiration, Drebbel removed the stopper from a bottle, filled with some liquid, which, by its evaporation, quickly rendered the air pure, and suitable for the purposes of respiration. This fact had been mentioned to Boyle by the friend of a man who had travelled in the vessel, by several relations of Drebbel's, and by a physician who married his daughter.

Experiment 43. When water, wine, or oil of turpentine were heated to ebullition, and placed in the air-pump receiver, the boiling recommenced on exhausting, and continued for some time; but hot salad oil could not be made to boil.

With this experiment Boyle concludes his letter, first apologising to Lord Dungarvan for not relating a larger number of experiments, many of which he had thought of and had wished to try, "were it not," he writes, "that my Avocations are grown so urgent for my remove from the place where the Engine was set up, that I am put to write your Lordship this Excuse, Weary, and in an Inne which I take in my way to my Dearest Brother Corke."

The account of the forty-three experiments detailed by Boyle in the treatise we have been considering, extends over 207 pages; but this may well be imagined from the extract given above from experiment 41.

In this first of Boyle's Pneumatic Treatises, there are an immense number of recorded facts; and when we remember the great difficulty of carrying out the experiments, we cannot too highly praise the industry and perseverance of their author. It is difficult for us, with our improved philosophical apparatus, to conceive the amount of labour attendant on the trial of experiments 200 years ago, when the few instruments which existed were to a greater or less extent imperfect. In the present day, if we wanted to make the last experiment mentioned above, we should place our vessel of hot water on the air-pump plate, cover it with a receiver, work the pump for a few minutes, and the experiment would be finished. In order to try the same experiment Boyle had to suspend a vessel of hot water in the receiver of his air-pump, and to cement on the cover of the receiver, and, while an assistant worked the piston, to alternately open the stop-cock of the receiver, close it, open the lateral valve, close it, again open the stop-cock, and so on, till the exhaustion was as complete as it could be; the whole apparatus was meanwhile shaken with every stroke of the pump, and leakage of air at the rather numerous joints was perpetually occurring.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

I.—The Novelties in the Pharmacopœia.

In commencing our notices of this important publication, we believe that we shall best serve the interest of our pharmaceutical readers by first of all giving a short account of the new compounds and preparations introduced, leaving a detailed criticism of the processes to a future occasion. The accounts will necessarily be short, as they are merely intended to give the pharmaceutist notice of the novelties with which it will be necessary to provide himself.

The first we come upon is under the head *Acetum*, where we find that vinegar made from French wine is to be used in place of vinegar made from malt. This preparation is a common article of commerce, but much that is sold under the name in this country is merely a dilute acetic acid, coloured and flavoured. It is here described as of a "straw colour," and is said to have a specific gravity ranging from 1·008 to 1·022.

Acidum Aceticum Glaciale is also a novelty to English pharmaceutists, although it was included in the last Dublin Pharmacopœia. This also is well known in commerce, being largely used by photographers. The best test of its strength is its solidifying when cooled to nearly 32° F.

We may here anticipate a remark we should have to make hereafter respecting the process given for the preparation of *Acidum Hydrochloricum*. Elaborate directions are given for mixing the materials and connecting the apparatus, but the writers have forgotten to mention that heat is to be applied to the mixture, so that, if the process be followed literally, very little, if any, hydrochloric acid will be obtained. This is a singular oversight of the compilers.

¶ Born 1493. Died 1541.

** Born 1572. Died 1634.

Acidum Sulphurosum.—Sulphurous acid has long had a limited use in medicine, though not in the Pharmacopœia. The acid ordered is a saturated solution of the gaseous acid in water, which has the sp. gr. 1·04.

Aconitia—aconitine.—A practicable process for the extraction of this alkaloid is given, but, as few will take the trouble to prepare it, we must once more caution our readers that the alkaloid made in this country only is to be relied upon. The article imported is, for the most part, worthless.

Ammoniæ Benzoas, benzoate of ammonia, is a salt well known to most of our readers. It has been but little used in medicine, but its introduction to the Pharmacopœia will no doubt increase the demand.

Ammoniæ Phosphas, phosphate of ammonia, is another novelty of which it is not necessary to say anything.

Antimonii Oxidum, the teroxide of antimony, is now used in the preparation of *pulvis antimonialis*, as it is now again called, or the *pulvis antimonii compositus* of the late Pharmacopœia. Pulvis antimonialis is now ordered to be made by the simple mixture of one part of the above oxide of antimony and two parts of precipitated phosphate of lime. This is, in one sense, an improvement, since a definite compound will always be obtained.

Antimonium Sulphuratum is the name now given to the tersulphuret of antimony.

Antimonii Terchloridi Liquor has also been added to the materia medica, since the above-mentioned oxide is ordered to be prepared from this solution by precipitating the oxichloride with water, and subsequently treating this precipitate with carbonate of soda.

Antimonium Tartaratum is the new name for the potassio-tartrate of antimony, a very simple mode of making which is now given. It consists simply in first mixing oxide of antimony and bitartrate of potash with sufficient water to form a paste, and allowing them to stand for twenty-four hours, and then boiling with more water for a quarter of an hour. The chemistry of this process will not perplex medical students, as older methods did; and examiners at the "Hall" will be deprived of a pet question.

Arnica, the root of the arnica montana, is used in the preparation of a tincture.

Atropia is employed in a liquor and an unguentum; the former in the proportion of four grains with one drachm of spirit and seven drachms of water, and the latter with eight grains of atropia to half a drachm of spirit and an ounce of lard.

Beberiæ Sulphas, sulphate of beberine, has been for some years a common medicine, and is probably well known to most of our readers. So also is

Bela, Indian bael, of which a form for a liquid extract is given.

Bismuthum Album is the new name for nitrate of bismuth, which is now prescribed in the form of lozenges, each of which is to contain two grains of the white bismuth, together with some carbonate of magnesia and carbonate of lime.

Several lozenges are prescribed in the Pharmacopœia; but as the preparation of these in an elegant form requires special appliances and some skill, the business will necessarily pass into the hands of the regular lozenge manufacturers, on whom the majority of pharmaceutists must rely for these articles.

Bucco is our old familiar friend buchu, of which a tincture as well as an infusion is now ordered.

Calcis Carbonas Precipitata is the article long in use for tooth powder, and now ordered to be used in the preparation of mistura cretæ.

Calcis Phosphas Precipitata is the phosphate of lime precipitated by ammonia from bone ash dissolved in hydrochloric acid. It is used, as mentioned above, in making pulvis antimonialis.

Calx Chlorata is the abbreviation now used for calx chlorinata.

Cannabis Indica now finds a place in the Pharmacopœia. An extract and a tincture are ordered, the tincture being made by dissolving an ounce of the extract in a pint of rectified spirit.

Carbo Animalis Purificatus, instead of being prepared from bullock's blood, is now intended to be bone black deprived of mineral matters by digestion with hydrochloric acid.

Chirata.—Chiretta is now officinal, and is used in a tincture and infusion. The infusion is made with a quarter of an ounce to ten ounces of water at 120°, and is to stand half an hour. The tincture is made with two ounces and a-half to one pint of proof spirit.

Chlori Liquor, a solution of chlorine, is another novelty here. The gas from six ounces of hydrochloric acid with an ounce of oxide of manganese is washed with a little water, and then passed into thirty-two ounces of distilled water. It is directed to be kept in a green glass bottle, well stoppered, and in a cool, dark place. It ought not, however, to be kept many weeks.

Cocculus, cocculus Indicus, is now used in the form of an ointment. Eighty grains of the seeds are to be well beaten in a mortar, and then rubbed with an ounce of lard.

Collodium is to be made by dissolving an ounce of gun cotton in thirty-six ounces of ether and twelve ounces of spirit.

Confectio Piperis we may mention as a new preparation, since it differs considerably from the old confectio piperis. It is now simply black pepper two ounces, carraway powder three ounces, and clarified honey fifteen ounces.

Conii Fructus.—Tincture of conium is now directed to be prepared with hemlock fruit instead of the dried leaves. Two ounces and a-half of the bruised fruit are to be macerated for forty-eight hours with fifteen ounces of spirit, and then percolated. When the fluid ceases to pass, the remaining five ounces of spirit are to be poured into the percolator. When the percolation is completed, the contents of the percolator are to be pressed, and proof spirit added to make up the pint.

Conii Succus is to be prepared from the fresh leaves, which are to be bruised and pressed, and one part of rectified spirit added to three parts of juice.

Creasotum.—A mistura creasoti is now ordered. The form is as follows:—Creasoti, sixteen minims; glacial acetic acid, sixteen minims; spirit of juniper, half a fluid drachm; syrup, an ounce; water, fifteen ounces. Mix the creosote and acid, then gradually add the water, and afterwards the syrup and spirit of juniper.

Crocus.—A tinctura croci, an ounce to a pint of proof spirit, is directed to be made by maceration and percolation, as in the case of the tinctura conii fructus.

Cusso means Kousso, ordered in the form of an infusion, the directions for the preparation of which would be enigmatical if the thing were not well known. The Pharmacopœia says:—"Take of kousso, in coarse powder, a quarter of an ounce; boiling distilled water, four fluid ounces. Infuse in covered vessel for fifteen minutes without straining." It is meant that the powder shall be swallowed, without which, we take it, the infusion would be of very little use.

Digitalinum is the active principle of fox glove, a process for making which is given. As most druggists must rely on the manufacturers for such articles as this, we need not at present notice this process, which otherwise possesses some interest.

Fel Bovinum Purificatum is ox gall purified by mixing it with rectified spirit, allowing it to stand for some hours, decanting from the sediment, and evaporating to a proper consistence.

(To be continued.)

PHYSICAL SCIENCE.

On the Spectrum of Thallium, by WILLIAM CROOKES, *F.R.S.*

THE present number contains a translation of a paper recently communicated to the Académie des Sciences by M. J. Nicklès.* The statements in it are so extraordinary, and so entirely at variance with the results of my experience, that I have been induced to try several experiments with the view of ascertaining whether I could detect any action of the kind there detailed.

M. Nicklès says that certain sodium compounds possess an antagonistic action to the green thallium line in the spectrum, that chloride of sodium especially has the property of obscuring the green ray, and that sodium compounds possess a paralysing action on the green thallium light. It is evident that M. Nicklès does not here allude to the obvious action which all coloured flames possess, when of sufficient intensity, of masking minute traces of other coloured light. There is no need to write a paper to explain that a large excess of salt on the wick of a spirit lamp will hide traces of thallium green in the same flame when seen with the naked eye; but the statement, that these two flames, when mixed, are incapable of resolution in the spectroscope, is one which must not be accepted without the most positive and unmistakable evidence. I know not whether there are thallium compounds which do not possess the property of developing the green spectral ray. I have not yet met with such compounds; and the following experiments show that the green line possesses too much vitality to be killed by any reasonable excess of chloride of sodium.

As recommended by M. Nicklès, an excess of a saturated solution of chloride of sodium was poured into a solution of acetate of thallium. The precipitated chloride of thallium was filtered off, and the clear liquid was tested in the spectroscope, a fraction of a drop being taken up on the end of a platinum wire bent into a loop. As soon as the moistened end was brought into the flame, a brilliant evolution of the yellow sodium band was observed, accompanying which was an almost equally brilliant flash of the thallium green line, lasting about half a second, and then suddenly vanishing. This is characteristic of most thallium compounds when present in small quantities. They are so volatile above a red heat, that the line partakes more of the character of a flash than a glow. Chloride of thallium is especially volatile, and it dissolves so slightly in cold water, or in solution of chloride of sodium, that it is difficult to get by means of the spectrum stronger evidence of its presence in water than is afforded by a momentary flash of green.

I next took two platinum wires looped at the ends. One of them had a bead of chloride of sodium fused on to it, whilst the other was dipped into a saturated aqueous solution of chloride of thallium. The thallic wire was introduced into the flame, and the brilliancy and duration of the green flash noticed. The bead of salt was next held in the flame; and whilst the whole of the apparatus was brilliantly illuminated with the intense yellow rays, and the field of the telescope was very bright, owing to irradiation round the yellow line, the other wire was dipped into the solution of chloride of thallium and brought into the flame. In spite of the dazzling light given out by the ignited salt, the green line was just as intense as when no salt whatever was present.

A piece of thallium wire, about six inches long, and weighing one grain, had the fiftieth of an inch cut from one end; the small fragment weighed, therefore, about the 300th of a grain. This was taken up on the end of a platinum wire, and the two were melted together. The end was now bent into a loop, and introduced into the flame of the spectroscope. The green line in this case appeared as a continuous glow, lasting, with little variation of intensity, for a considerable time. Whilst observing the line, a bead of chloride of sodium was brought into the flame, and after a few seconds removed, this being repeated two or three times, and careful notice being taken whether the green line suffered any diminution of intensity. No alteration whatever was apparent, allowance being made for the seeming slight diminution of brightness caused by the brilliant illumination of the field of the telescope.

The alloyed end of the platinum wire (from which most of the thallium had by this time been burnt away) had, as nearly as possible, half a grain of chloride of sodium melted on to it, and it was then again introduced into the flame of the spectroscope. The thallium, in this case, was burnt in the presence of nearly a thousand times its weight of chloride of sodium; here, if at all, the paralysing action of sodium should be apparent; but I could not detect the least interference whatever between the two lines, which glowed side by side in total indifference as to each other's existence.

I consider these experiments conclusive; and more accurate details of the conditions under which the thallium line is destroyed by sodium, are required before such an extraordinary statement can be admitted as correct.

Note on the Spectral Ray of Thallium, by M. J. NICKLES.

I HAVE found that there are thallic compounds which do not possess the property of colouring flames green, nor of developing the characteristic spectral ray; these are compounds containing sodium, especially chloride of sodium. By its flame and its yellow rays, this chloride completely hides the green line.

If chloride of thallium is insoluble in cold water, it is not so in water saturated with chloride of sodium. For instance, on pouring this latter into acetate of thallium, a precipitate of chloride of thallium is formed; but the mother liquors contain a notable quantity of the latter without being able to colour the gas flame *green*.

If, therefore, amongst the rays of the solar spectrum the characteristic one of thallium has not been observed, this does not by any means prove that this metal does not exist in the sun, as has been supposed; for if it has not been proved to be present, soda has been found, and the object of this note is to make known the paralysing action of this metal when present in a certain proportion.

This incompatibility between the thallium and sodium rays should also be taken into serious consideration in

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* *Comptes Rendus*, lviii., 132.

toxical or medico-legal researches; for when it is in combination with liquid or solid animal matter, soda may likewise be present, and in sufficient quantity to nullify its action on the flame, and thus seem to show the absence of this poisonous metal.

At the same time, if it be desirable to look for this interesting simple body in mineral water, mother liquors, and generally all saline waters containing an excess of chloride of sodium, it is necessary to begin by separating it first from the excess of soda, either by reducing it with pure zinc, or by extracting it with a battery; or, lastly, by precipitation with sulphide of ammonium, or iodide of potassium.

With reference to this last, I find that liquids containing chloride or bromide of thallium in solution are precipitated by iodide of potassium, producing iodide of thallium of a beautiful yellow colour, insoluble in the precipitating iodide, but tolerably soluble in distilled water.—*Comptes-Rendus*, lviii., 132.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IV.—*Saturday, December 19, 1863.*

Ladies and Gentlemen,—In the last lecture we entered upon the subject of carbonate of lime, and considered the varieties of that compound occurring in nature. There are, you will remember, three: the amorphous state of carbonate of lime, represented by chalk; the prismatic crystalline state, represented by arragonite; and the rhombohedral, represented by calcite. We then proceeded to examine the conditions under which arragonite and calcite are respectively formed; and I think you must all have been struck with the remarkable facts which have been discovered by Rose with respect to this subject. We have seen that apparently the most trifling alterations in respect of dilution and of temperature are sufficient to determine the crystallisation of carbonate of lime in one or other of those forms—facts which are, apparently, insignificant in themselves, but in relation to geology may have an important bearing, as indicating the precise conditions which may have obtained in former periods where we discover the presence of those bodies.

At the beginning of the last lecture I called your attention to a curious illustration founded on experiment by Deville; and, as I do not appear to have made myself clearly understood, perhaps you will allow me a minute or two to explain it again. I say this, because I have been asked questions upon the subject which clearly prove that I failed to render myself as intelligible as I ought to have done. The experiment relates to an interesting mineral termed "staurolite." I sketched rudely a diagram representing a tube containing successive layers of alumina and silica. I then supposed that this tube was heated. I will draw it horizontally this time, so as to make it perfectly clear. You pass the gas in at one end. We have here in one compartment alumina, then silica, then alumina, then silica again. The gas we pass through is a compound of fluorine and silicon. The mineral that we want to form is a compound of silica and alumina—a silicate of alumina in fact. Fluoride of silicon—that is, fluorine and silicon—enters the tube previously heated. The change that takes place in the first segment, or partition, here represented, is this: some of the aluminium is removed, and combines with the fluorine, and passes over as fluoride of aluminium, whilst a corresponding or equivalent amount of the fluoride of silicon is there deposited, forming the mineral in question. The gas which enters is fluoride of silicon; the gas which leaves the first apartment is fluoride of aluminium. This then acts upon the silica, and a corresponding change takes place in the next partition. The aluminium is deposited, and the silicon escapes in conjunction with the fluorine. Then we have the fluoride of silicon acting upon the aluminium; then the fluoride of aluminium acting again upon the silicon, and so forth; so that with a small definite amount of fluorine you are able in this way to convert an indefinite quantity of alumina and silica into the mineral in question. It is not pretended that a process identically the same as that which I have been describing is actually occurring, or has occurred in nature; but it is remarkably illustrative, as showing the possibilities, at all events, of the formation of minerals of this kind. I hope I have now succeeded in rendering that plain which I had left obscure on a former occasion.

In regard to the source of lime in nature, you find lime everywhere. In almost all the so-called Plutonic rocks lime exists. It is there in combination with silica, as a silicate of lime; and the silicate of lime may be easily extracted from these rocks by the solvent action of water, especially water containing carbonic acid. One of the most remarkable and highly calciferous minerals with which we are acquainted, is the well-known labradorite, or calciferous soda felspar, containing 15 or 16 per cent. of lime, which is the maximum, and 6 per cent. of soda. Of all such calciferous rocks, perhaps this is the most easily decomposed by carbonic acid; and, therefore, there is no difficulty whatever in accounting for the extraction of lime from this rock by ordinary atmospheric influences. Woollastonite, or tabular spar, which is a silicate of lime in which the oxygen of the silica is exactly double that of the base, may also be decomposed by water containing carbonic acid. This may be a source of lime. There is no difficulty whatever, in fact, in accounting for the extraction of lime from those rocks which contain it, and which are supposed to have been developed by igneous agency. I will show you presently, when I speak of silicates, a specimen of woollastonite artificially prepared last night at a high temperature. It is one of the best I have seen. I have often made it in small crystals; but here it is in very distinct crystals, prepared by fusing the lime and the silica at a high temperature.

We next pass on to the examination of a remarkably interesting mineral, and one which is highly instructive in its geological bearings, namely, fluor spar; that beautiful mineral constituting the well-known ornamental objects which we see in various establishments, and having the common name of "blue John." Fluor spar is certainly one of the most interesting minerals with which we are acquainted. It crystallises in the cubical system, and occurs in various modifications of that system. Some of these varieties are remarkably phosphorescent. I have one such before me, called chlorophane. I am afraid almost that the light here will be too intense to enable you to see it at any considerable distance; but I think I shall be able to get evidence enough of the development of light to illustrate the fact, at all events. It somewhat decrepitates on heating. I have placed some of this fluor spar on the end of a piece of platinum, and you can already perceive distinctly the green light which it emits, and which will shortly become still more conspicuous. This is a remarkably fine specimen; and I regret that I cannot present these illustrations on a larger scale. That, however, would be utterly impossible; so we must content ourselves with these very small exhibitions of the fact. Fluorine is widely diffused in nature; in fact, fluorine may be said to exist everywhere, even in animal structures. Fluor spar contains exactly 48·53 per cent. of fluorine, the rest being the metal calcium; its specific gravity is, as nearly as may be, 3. It ranges from 3·017 to 3·188. Now, with respect to its solubility. This is a point of chief importance in regard to geological influences concerning fluor. The late Dr. Wilson, of Edinburgh, found that carbonic acid passed through water containing finely suspended fluor dissolved so much that he could, without difficulty, detect the presence of lime in that water by the ordinary reagent—oxalate of ammonia. We see, then, that fluor spar is sensibly soluble in common water by the agency of carbonic acid, and not only so, but the fluor spar is actually soluble to a certain extent—to a very limited extent, it is true—in pure water. He found that one part of fluor spar dissolved in 26923 parts of pure water; and the solubility of it was somewhat increased by heat. Fluor spar and silica may coexist dissolved in water; but no silico-fluoride of potassium is ever formed under these conditions. The fluor spar is partially decomposed by a hot aqueous solution of an alkaline carbonate with the formation of alkaline fluoride and carbonate of lime; and this decomposition may possibly occur in hot alkaline mineral waters where fluor spar may be present. Fluor spar was obtained crystallised by Senarmont at 250° centigrade during sixty hours. The experiment was made by heating recently precipitated gelatinous fluoride of calcium—a salt easily made by double decomposition in the laboratory of the chemist. By heating that in a sealed glass tube at 250° centigrade, during sixty hours, with a solution of an alkaline bicarbonate, and also with the insertion of a little bulb containing hydrochloric acid sufficient to act upon the bicarbonate, and to evolve carbonic acid, he succeeded in obtaining the fluor spar distinctly crystallised. There is no necessity, I take it, for supposing the existence of a high temperature during the formation of fluor spar under natural conditions. We have seen just now that the fluor spar is soluble, not only in pure water, but still more so in water containing carbonic acid, which everywhere occurs in nature. And this cause is quite sufficient of itself to enable us to explain the formation of these beautiful and magnificent crystals of fluor spar, which we meet with in mineral lodes. Time is the great element; but what is time in a geological sense? A thousand years is hardly as one day; and, when we have to deal with these enormous periods, there is no difficulty at all in accounting for the formation of those magnificent minerals by the slow, yet certain, operations of nature. Now, with regard to the influence of heat upon fluor spar: this is a point of considerable consequence. It may be supposed by some that fluor spar might have been injected in a molten state into mineral veins; but I believe there is no instance in which it can be shown that, where fluor spar exists to any great extent in mineral veins, the veins themselves have presented any indication of igneous action. Still, it is by no means impossible; for we find that fluor spar can be fused, and rendered perfectly liquid, at a very high temperature. I have here the result of an experiment, which happens to have turned out remarkably successful. A piece of blue fluor was put into a platinum crucible, and then exposed to a very high temperature. It fused beautifully, and, as good luck would have it, there is a large cavity in the interior, and in that cavity you see protruding delicate octahedral crystals as distinct as possible. Dr. Wilson detected fluor in various rocks—for example, the Aberdeen and Peterhead granite, and various trap-rocks from the vicinity of Edinburgh. In fact, fluorine is everywhere; and almost every element of nature we shall find by-and-by, I suppose, to be everywhere—in minute proportions, it is true. It occurs in numerous minerals, especially various micaceous minerals, in pyrochlore, zircon-syenite, certain varieties of hornblende, topaz, pycnite, chondrodite, and, as we have seen, in cryolite also abundantly. Almost all, if not all, fluor (by fluor I mean fluoride of calcium) seems to be a secondary product, derived from minerals containing fluorine decomposed by the action of percolating water.

The pseudomorphs we meet with in mineralogical cabinets tell a very important story with regard to the formation of fluor, and also other mineralogical specimens which are too apt to be despised by many persons. Many most interesting, though unattractive, specimens to the eye, capable of telling a wonderful history with regard to their formation, we have seen rejected as not being particularly good in point of formation of crystals, or not fine in the dealer's sense. Specimens which are looked upon with contempt are often in the highest degree instructive. With regard to these pseudomorphs, we find that one in particular, to which I wish to direct your attention, is by no means of uncommon occurrence—namely, the pseudomorph quartz. We find sometimes large crystals of fluor spar coated beautifully with quartz, or, in fact, presenting a cube of quartz, the fluor spar having been more or less—sometimes completely—removed, thus showing that the solvent action, whatever it may have been, which was capable of removing fluor, was not capable of acting upon the quartz. This, then, may furnish us with a very interesting indication with regard to the agents concerned in producing these forms. In further proof of the aqueous origin of fluor, I might mention the fact, that fluor crystals are sometimes—nay, not very unfrequently—found to contain water. Fluor spar has been found in the deposit of certain mineral springs—the Carlsbad springs, for example, where it was first detected by Berzelius. From those springs, according to Bischoff, who has made the calculation, the quantity of fluor spar extracted naturally, and naturally deposited, is supposed to be 24,700 lbs. Hence, as he said, there is no difficulty in the lapse of ages in accounting for the formation of considerable accumulations of fluor spar even from this source.

I might say a great deal more about the compounds of lime; but I am afraid I must draw to a close with these observations upon fluor, and proceed at once to the subject of magnesium. The metal magnesium forms the base of the well-known magnesia. It is only lately that we have been able to separate these metals from their bases in anything like respectable proportions; and now magnesium bids fair to become an article of commerce like aluminium. It is a metal similar in appearance to aluminium—whiter in point of colour. It is a remarkably light metal—lighter even than aluminium. It is malleable, and can be hammered or rolled out like aluminium. It can be drawn out into wire; and recently a process has been adopted for its extraction on a large scale; so that now we may have magnesium by the pound. It has a strong affinity for oxygen at a high temperature. Although, as was the case with aluminium, it requires an extraordinary amount of force to separate the magnesium from its combination with oxygen, yet, when separated, it is remarkable how stable the metal is at the ordinary temperature of the air. If, however, we apply heat, it will take fire, combining with oxygen, and producing a wonderfully intense light. It can be used with advantage for photographic purposes. I think you will be able to see distinct evidence of this. Only imagine a globe of magnesium surrounded with an atmosphere of oxygen burning for ages, and producing a light as bright as that of the sun!

Magnesia consists of one equivalent of the metal magnesium and one of oxygen. It is largely diffused in nature, where it exists in combination with carbonic acid, and it also exists very extensively in combination with silica, as we shall see hereafter.

But the carbonate of magnesia is the salt especially to which I have now to direct your attention. I have produced here in this glass case a quantity of magnesia, just to give you an idea of what it appears like by the precipitation of magnesia from common Epsom salts in the ordinary way—by carbonate of soda. Carbonate of magnesia thus produced occurs as a white amorphous powder, perfectly non-crystalline. It may, however, be obtained crystallised, and when crystallised it is known under the term of magnesite. In nature it occurs both crystallised and amorphous; and, in some localities, carbonate of magnesia is found remarkably pure, and in large quantity. I recollect some years ago seeing some large glass works, where I think I may say I saw some hundreds, if not thousands, of tons of almost pure carbonate of magnesia, imported somewhere from Greece. It was employed in the manufacture of soda. I was wonderfully struck with the enormous quantity of it, and with the fact of the importation of carbonate of magnesia nearly chemically pure, for we examined it, and found scarcely a trace of impurity in it. It occurs also in various other localities, on the continent, and elsewhere. Carbonate of magnesia is thrown down in an amorphous state by precipitation from solution, and it may be obtained crystallised by the action of neutral carbonate of soda on sulphate of magnesia at a temperature of 160° centigrade. There it is at the ordinary temperature amorphous. But if precaution be taken to raise the temperature during the precipitation or afterwards, then you may have it distinctly crystallised, and it requires 160° centigrade to produce that effect. It occurs, massive, as I have said, abundantly, and crystallised, in various localities. With regard to the solubility of carbonate of magnesia in pure water: one part dissolves in 4006 times—say, in round numbers, 4000 times—its weight of water. And one part of magnesia dissolves in 742 parts by weight of water containing carbonic acid. Carbonate of magnesia exists dissolved in sea-water. In the water of the ocean between Belgium and this country, Bischoff found one part dissolved in 6060 parts of water. There is, therefore, in sea-water a copious source of carbonate of magnesia. Carbonate of magnesia is decomposed at a low temperature by heat—in fact, at a much lower temperature, I believe, than carbonate of lime, and this is a point of considerable interest. One or two manufacturing processes have actually been founded upon this fact. If you take carbonate of lime—limestone, and heat it in a close retort, for reasons assigned on a previous occasion, you will not find carbonic acid liberated—not at all easily except at a pretty high temperature, and then not easily, unless some other gas than carbonic acid gas—the vapour of water, for example—is passed over it. This is not the case with carbonate of magnesia. It decomposes, as I said just now, at a comparatively low temperature, so that when you have a double compound of carbonate of magnesia and carbonate of lime known as dolomite, to which I shall presently direct your attention, and heat that in a close vessel at a low temperature, carbonic acid distils off from the magnesia easily and may be collected, leaving the carbonate of lime almost unchanged. That is an important point in reference to geological matters, as we shall see hereafter. This fact is not generally known. A patent was taken out for the process a good many years ago. I saw it myself in operation nearly thirty years ago. The carbonic acid produced was intended to be applied in the manufacture of carbonate of soda. It is a curious point, that although the dolomite was apparently very pure and free from organic matter, there being no trace of organic matter to the eye in the dolomite that was employed, yet the quantity of offensive gas resulting from the destruction of some invisible organic matter in that dolomite, rendered the process eventually unserviceable, snd it was abandoned in consequence. No doubt, if such a piece of dolomite were examined by the chemist in his laboratory, he would fail to detect the presence of organic matter in it; but when we operate upon a large scale, we get decisive results, which we fail to obtain on a small scale. The fact is worthy of note, as showing that even dolomite which appears to be perfectly pure, free from the contamination of organic matter, may yet contain it in sufficient quantity to render the carbonic acid liberated from it when heated, exceedingly offensive by its odour,—for the odour could only have arisen from the presence of organic matter.

With regard to silicate of magnesia, it occurs abundantly in nature. It is slightly soluble in water, but I do not find that the degree of solubility has been exactly ascertained. Here is a point to be noticed. Silicate of lime, we have seen, is decomposed easily enough by carbonic acid and water. Even when the silicate is simply mechanically suspended in the water, it yet may be decomposed by the carbonic acid. According to Bischoff, this is not the case with silicate of magnesia. This point may be exceedingly important in its geological relations. Silicate of magnesia, according to him, cannot be decomposed by carbonic acid when merely suspended in water. It must be actually dissolved therein to suffer decomposition by this acid.

(To be continued.)

ACADEMY OF SCIENCES.

January 18, 1864.

M. Damour communicated a note "*On the Density of Zircon.*" This has been found to vary between 4·04 and 4·67. The author found that by calcination at a white heat the density increased from $\frac{1}{16}$th to $\frac{1}{12}$th. He infers that the specific gravity of the mineral depends upon its molecular state. The infusibility of zircon is remarkable. M. Damour could only fuse a thin layer of the surface by using the oxyhydrogen blow-pipe.

M. Pisani presented an analysis of an aërolite which fell near Louvain on December 7, last year. The density of the stone was 3·525. It was composed of—

Iron, with nickel, tin, and traces of phosphorus	8·67
Iron pyrites	6·06
Chromated iron	0·71
Silicates	84·28
	99·72

The silicates appear to have been a mixture of augite and felspar.

A note by M. Maumené "*On the Artificial Preparation of Pure Oxalic Acid,*" was presented.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(TENTH NOTICE.)

(*Continued from page* 46.)

The first of the organic products mentioned in the Report is oxalic acid, and the greatest novelty in connexion with this article since 1851 is the manufacture from sawdust, which naturally occupies some space in the report. A well-merited compliment is here paid to the enterprise and skill of Messrs. Roberts, Dale, and Co., of Manchester, who have perfected this and many other industrial processes. Gay-Lussac so far back as 1829 showed that oxalic acid was produced when sawdust was heated with caustic potash; and later, M. Possoz announced that this effect was more easily produced when a mixture of potash and soda was employed, than when either alkali was used alone. It remained, however, for Messrs. Dale and Co. to make it an industrial process. That they have succeeded the market price of oxalic acid sufficiently shows. In 1851 the price was 15d. or 16d. per lb.; it is now 8d. or 9d.

The Report states that the manufacture will probably remain a monopoly, on account of the enormous amount of fuel required, an expenditure of forty tons of coal being necessary to produce one ton of oxalic acid. We give an outline of the process. A mixture of two equivalents of soda and one of potash in solution is evaporated to about 1·35 sp. gr. At this stage, sawdust is introduced as long as it will dissolve. The paste produced is placed in thin layers on iron plates, which are heated to about 250° C., and the paste stirred until the materials are perfectly dried, but without charring. About 28 to 30 per cent. of oxalic acid is thus obtained, which is separated in the following way:—The mass is treated with water heated to 15° C., in which all dissolves but the oxalate of soda, which, being but slightly soluble, falls to the bottom. The oxalate of sodium is then decomposed by boiling with hydrate of lime, and the resulting oxalate of lime is decomposed by the use of three equivalents of sulphuric acid to one of the oxalate. The solution of oxalic acid is run out, evaporated, crystallised, and purified. From two parts of sawdust one part of oxalic acid may thus be obtained.

Acetic acid is also made from saw-dust. The material is slowly delivered to the retort by means of a hopper, and the residual finely-divided charcoal is carried into a vessel of water. This method is not, however, considered very remunerative, and the distillation from split blocks is continued. A great improvement in this manufacture is that patented by Mr. Condy, who destroys the empyreumatic matters by a rectification with bichromate or permanganate of potash. A remarkably pure acid is thus obtained, which may be used for "fortifying" malt vinegar in place of the mineral acid which the law allows.

The use of the crude acid for the preparation of the acetate of iron, and other acetates for mordants, is without objection; but for other purposes a purer acid is required. This is obtained by converting the crude acid into acetate of soda, or acetate of lime, purifying these first by distillation to get rid of methylic spirit, and then, by heating, to char other foreign matters, and finally dissolving and recrystallising the salt, which is afterwards decomposed by sulphuric acid.

A process for the preparation of glacial or monohydrated acetic acid is here given, which we may quote at length, since the consumption of this article in England is likely to be increased by its introduction into the British Pharmacopœia:—

"Nearly twenty years ago, M. Melsens, a distinguished Belgian chemist, observed that ordinary acetate of potassium, when supersaturated with ordinary acetic acid, yields on evaporation an acid salt containing, according to his analysis,

$$KC_2H_3O_2,HC_2H_3O_2.$$

"The concentrated solution solidifies on cooling to a crystalline mass. The crystals of this salt may be heated *in vacuo* to 120° C. without losing weight. At 148° C. the salt fuses with loss of a minute quantity of acid; at 200° C. it begins to boil, evolving vapours of crystallisable hydrate of acetic acid; at 300° C. the retort contains neutral acetate of potash, which is decomposed only when the temperature is still further raised. M. Melsens expressed at the time the opinion that this observation might be utilised for the production of monohydrated acetic acid on a large scale. Indeed, if neutral acetate of potash be distilled with an excess of moderately dilute acetic acid, the salt fixes part of this acid, whilst another portion, more dilute, passes over. Gradually the concentration of the acid increases, and ultimately a point is reached when the distillate solidifies. It is necessary to keep the temperature below 300°, since the distillate becomes coloured and acquires an empyreumatic odour if the heat be increased beyond that point."

The manufacture of tartaric acid offers nothing of particular interest; but we may quote what the Reporter saw at the works of M. C. Kestner, at Thann. The method of separating tartaric acid there adopted is the following:—

"The crude tartar is dissolved in hydrochloric acid, which separates at once the greater part of the organic impurities, and also some colouring matters insoluble in hydrochloric acid. The solution is then precipitated by lime, and the tartrate of lime decomposed by sulphuric acid."

The purification is effected in the usual manner.

We come next to dyeing matters, which must necessarily occupy a larger space; and at this point we may mention that the collected reports of the juries are now issued in a 15s. volume. The Report we are noticing is not yet to be had in a separate form—at which we must once more protest—since it appears to us to be almost the only one worth purchasing.

Chemistry. By the late George Wilson, M.D., F.R.S. Revised and enlarged by Stevenson Macadam, Ph.D., &c., &c. (Chambers' Educational Course.) London and Edinburgh: W. and R. Chambers.

An Introduction to Chemistry; including a Popular Summary of Animal and Vegetable Physiology. London: Hardwicke.

The first of the above-named books may be said to be the best elementary work on chemistry ever published.

The second is one of "Hardwicke's Elementary Books," a very cheap series of works, intended by that enterprising publisher to spread a knowledge of scientific principles among the labouring classes. The series deserves a great success.

First Outlines of a Dictionary of the Solubilities of Chemical Substances. By Frank H. Storer. Part II. London: Trübner and Co. Cambridge (U.S.): Sever and Francis. 1863.

We have much pleasure in noticing the second part of this valuable work, which carries it on from "Convolvulinolic Acid" to "Protoxide of Tin." It is not necessary for us to say anything of the design and execution of the work; the following extracts will give our readers an idea of both:—

"Cyanide of Silver.—($AgC_2N = AgCy$.)—Insoluble in water, and in dilute nitric acid. (Fresenius, *Quant.*, p. 142.) Sparingly soluble in dilute nitric acid; more readily in boiling than in cold. (Thawlow). Unacted upon by other dilute oxygen acids. Decomposed by strong acids. (Ittner.) Not soluble to a perceptible extent in commercial cyanhydric acid. (Gore.) Soluble in aqueous solutions of the cyanides of ammonium, potassium, sodium, calcium, barium, and strontium.

"Very soluble in aqueous solutions of the cyanides of potassium and of sodium, of chloride of ammonium, and of hyposulphite of soda. (Gore.) Soluble in boiling aqueous solutions of the chlorides of potassium, sodium, calcium, barium, and magnesium; but at ordinary temperatures this solution takes place very slowly. Also soluble in solutions of hyposulphite of soda, ferrocyanide of potassium, carbonate, sulphate, nitrate, and succinate of ammonia, and in a large excess of a hot solution of chloride of ammonium. Soluble in ammonia water. (Wittstein.) Easily soluble in ammonia water, but is not decomposed by solutions of the caustic alkalies. (Berzelius, *Lehrb.*) Soluble in a strong boiling solution of nitrate of silver. (Wœhler.) Slightly soluble in an aqueous solution of citrate of soda. (Spiller.) Soluble in an aqueous solution of nitrate of protoxide of mercury, from which it is precipitated on the addition of cyanhydric acid, but it is not precipitated either by nitric acid or by a solution of nitrate of silver. (Wackenroder, *Ann. Ch. u. Pharm.*, 41. 317.) Easily soluble in ammonia water. Not decomposed by the fixed alkalies.

"Nitrite of Silver.—Very sparingly soluble in cold, more soluble in warm water, from which it is deposited as the solution cools. (Persoz, *Ann. Ch. et Phys.*, (3.) 23. 50.) Soluble in 120 pints of cold water; more soluble in hot water. (Mitscherlich.) Soluble in 300 pints of cold water. (Fischer.) Insoluble in alcohol.

"Oxalate of Lime.—($C_4 Ca_2 O_8$ + 2 Aq & 6 Aq.) Permanent. Almost insoluble in water; the presence of free acetic or oxalic acid increases its solubility slightly. It is soluble in strong acids. (Fresenius, *Quant.*, pp. 128, 772.) 'The solubility of oxalate of lime (in water) is $\frac{1}{500000}$.' (Malaguti, *Ann. Ch. et. Phys.* (3.) 51. 347.) Insoluble in water, acetic acid, or a solution of chloride of ammonium. (Scheele.) Insoluble in water, oxalic acid, or acetic acid. Easily soluble in chlorhydric and nitric acids. (Wittstein's *Handw.*) Even when recently precipitated, it does not appear to be soluble either in hot or cold aqueous solutions of chloride of ammonium (Brett, *Phil. Mag.*, 1837, (3.) 10. 96; Wackenroder, *Ann. Ch. u. Pharm.*, 41. 316) or of nitrate of ammonia. (Brett, *Ibid.*) Insoluble in aqueous solutions, even when these are hot and concentrated, of the chlorides of ammonium, sodium, potassium, barium, strontium, and calcium; on the contrary, it is easily soluble in hot, tolerably concentrated solutions of salts of the 'magnesia group' (*ex. gr.* of manganese, magnesia, &c.), from which solutions it is precipitated on the addition of an excess of oxalate of magnesia. Insoluble in solutions of the salts of oxalic acid. (Souchay & Lenssen, *Ann. Ch. u. Pharm.*, 100. 323.) Soluble in an aqueous solution of chloride of magnesium, from which it is precipitated, together with some magnesia, by an excess of oxalate of ammonia.

"Soluble in an aqueous solution of neutral citrate of soda. (Spiller.) In presence of much chloride of calcium, of sodium, or of ammonium, it is completely soluble in protochloride of copper (CuCl), but after a while oxalate of copper separates out. (Reynoso.) Slightly soluble in water containing chloride of manganese. (Turner.) Very sparingly soluble in oxalic acid. (Bérard.) Slightly soluble in lactic acid. (Cap & Henry.) Soluble in considerable quantity in strong phosphoric acid, especially when this is warm. This solution may be largely diluted with water without being precipitated. (Neubauer, *Ann. Ch. u. Pharm.*, 99. 223.) Insoluble in cold, concentrated nitric acid, decomposed when heated therewith, also decomposed by concentrated sulphuric acid. Tolerably soluble in chlorhydric and in slightly diluted nitric acid. From the saturated chlorhydric acid solution, portions of it are precipitated both on addition of oxalic acid and of chloride of calcium. (Gladstone.)

"Oxalate of lime is not precipitated when a neutral aqueous solution of oxalate of alumina is mixed with a neutral solution of the hyposulphite or nitrate of lime, or of chloride of calcium. (Herschel, *Edin. Phil. Journ.*, 1819, 1. 21.) Lime cannot be entirely precipitated by oxalic acid from solutions which contain sesquioxide of chromium, of iron, or of alumina, since double oxalates which are somewhat soluble in water, form in the mixtures. (Reece.) Insoluble in an aqueous solution of cane sugar. (Bergman, 'Essays,' 1. 318.)"

The above articles sufficiently testify to the value of the work to the practical chemist.

NOTICES OF PATENTS.

2552. *The Preparation of Colouring Matters from Aniline.* W. and W. H. Watson, Harrogate, Yorkshire. Dated September 17, 1862. (Not proceeded with.)

The inventors act upon aniline with half its weight of nitro-hydrochloric acid (aqua regia) at or about the temperature of 140° Fahr., whereby a mixture of colouring matters is gradually formed. For the separation of these the raw product is treated with water, which dissolves out the red dye, leaving a blue colouring matter and dark-brown resin insoluble. This residual portion is further treated with alcohol, in which it is completely soluble, and benzole added to the solution in the proportion of six times the bulk has the effect of precipitating the blue substance in a state of purity. This last product is then dissolved for use in alcohol or methylated spirit.

The directions given in this specification are practically identical with those described one month earlier by Mr. John S. Blockey, of Leeds.*

2604. *An Improved Composition for Painting.* R. A. Brooman, Fleet Street, London. A communication. Dated September 24, 1862.

This paint is prepared by mixing together two distinct compositions, which are to be incorporated only at the time of using.

I. Liquid Compound.

Oxalic acid	65 parts.
Sugar, or other saccharine matter .	60 ,,
Salts of tartar, or other carbonated alkali	100 ,,
Soft soap	25 ,,
Water	750 ,,

II. Pigments, &c.

White lead, or zinc white . . .	125 parts.
Boiled linseed oil	125 ,,
Driers, of any kind	500 ,,
Litharge	50 ,,
Soft soap	200 ,,

It is preferred to use soap, which contains a certain quantity of an alkaline silicate, in admixture with the fatty ingredients. The zinc or lead white may be partially replaced either by chalk or sulphate of baryta.

2605. *Treating and Preparing Madder for Dyeing Purposes.* W. Maddick, Jun., Liverpool. Dated September 24, 1862.

The patentee's first claim consists in treating madder for dyeing purposes, after being ground, by damping or saturating with water, and then allowing it to stand for a period not exceeding twenty-four hours previously to being placed in the dyeing bath or beck. The second head of the invention refers to modes of applying the madder dye.

This fermentation treatment appears to be directed to the removal of the yellow colouring matter, which is usually destroyed by sulphuric acid.

2634. *Certain New and Improved Applications of Petroleum and its Products, certain Agents Produced by Combining the same with other Substances, and certain Modes of Treating Caoutchouc, Gutta-percha, and their Compounds and Substances similar thereto.* M. Henry, Fleet Street, London. A communication. Dated September 27, 1862.

This invention refers to the employment of American petroleum, or of native mineral oils from other sources, or of products obtained from these by distillation, for vulcanising caoutchouc, and for a variety of other manufacturing purposes. The liquid hydrocarbons proposed to be employed are the following:—First, a colourless liquid of ethereal odour, and specific gravity ·669, and boiling at the temperature of 154° Fahr. This product constitutes the chief bulk of the distillate obtained from American oil, and has been named the hydride of caproylene by Cahours and Pelouse. The second product has a boiling point of 203° Fahr., and the third liquid is a heavy oily body, distilling at about 320°. These hydrocarbons are employed as solvents either separately or in admixture.

2645. *Improvements in the Manufacture of Compounds of Silica, and in the Application of Certain Compounds of Silica to Mineralize Woven Fabrics, Paper, and Paper Pulp; to Harden and Preserve Stone and Cement; in the Production of Artificial Stone and Paint, and in the Glazing of Porcelain and such like Manufactures.* H. Ellis, Bangor, North Wales. Dated September 29, 1862.

The patentee manufactures a variety of compound silicates by first precipitating the metallic or earthy silicate in the

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* Chemical News, vol. ix., p. 11.

ordinary manner by double decomposition between the silicate of an alkali and a soluble metallic salt; the product so obtained is collected on a filter and washed; it is then redissolved at once to saturation in a solution of silicate of soda or potash. If the gelatinous precipitate has been allowed to dry, it will require boiling with the silicate, in order to become completely dissolved. The addition of alkaline carbonates, borates, and phosphates, will facilitate the solution of the gelatinous silicates, and the double compounds so formed may be preserved in air-tight vessels until required for the purposes named in the heading.

2654. *Manufacture of Varnish, Printing Ink, Paint, and Printing Colours.* A. Prince, Trafalgar Square, London. A communication. Dated September 30, 1862.

This invention consists in the application of petroleum, or products distilled therefrom (instead of linseed oil), to the manufacture of varnish, printing ink, paint, and colours of every description. Instead of natural petroleum the oil distilled from coal and schist may be employed.

Grants of Provisional Protection for Six Months.

3213. William Henry Tooth, Rhodeswell-road, Stepney, Middlesex, "Improvements in the manufacture of iron and steel, and in the machinery, apparatus, and furnaces used therein, and for the production and application of gas to be employed in such manufacture, and the application of parts of the said apparatus to the manufacture of glass and alkali."—Petitions recorded December 19, 1863.

3037. Richard Archibald Brooman, Fleet Street, London, "Improvements in the distillation or treatment of bituminous substances."—A communication from John Saunders, New York, U.S.

3044. James Bowron, South Stockton, Yorkshire, and George Robinson, Welbeck Street, Cavendish Square, London, "Improvements in the manufacture of soda and sulphuric acid."—Petitions recorded December 3, 1863.

3080. George Charles Grimes, Wandle Terrace, South Street, Wandsworth, Surrey, "Improvements in the manufacture of fusees, vesuvians, or other cigar or pipe lights, and in the means or apparatus employed in the manufacture of cigar or pipe lights, lucifer matches, and vestas."

3114. John Anthony Pols, St. Martin's Street, and Peter Owen Bernard, London, "Improvements in obtaining purified or refined oils, and in obtaining oil-cakes from cotton seed and other vegetable substances, also in refining or purifying cod-liver oil."

3116. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of india-rubber and gutta-percha compounds."—A communication from Thomas Mayall, Roxburgh, Massachusetts, U.S.—Petitions recorded December 10, 1863.

3152. John Wright, Marple, near Stockport, Cheshire, "Improvements in the manufacture of superphosphate of lime."

3154. Eugene Rascol, Brydges Street, Covent Garden, London, "Improvements in the manufacture of glass."—A communication from Tony Petitjean, Geneva, Switzerland.

3157. Samuel Edwards, Birmingham, "Improvements in grinding pearl, and which said improvements are also applicable for grinding other materials."

3160. William Thornthwaite, Newgate Street, London, "Improvements in the manufacture of chromate of potash, chromate of soda, and other salts of chrome and soda and potash."—Petitions recorded December 14, 1863.

3168. Henry Chadwick, Topsham, Devonshire, and John Clench, Exeter, "Improvements in utilising the waste liquors resulting from the preparation of fibrous matters in paper pulp making, and in the machinery or apparatus to be used therein."

3169. Axel Starck, Leadenhall Street, London, "Improvements in the manufacture of paper from a material not hitherto used for that purpose."—A communication from Matthew Carter, Barcelona.

3297. John Patterson, Beverley, Yorkshire, "Improvements in machinery or apparatus for grinding, crushing, and hulling or shelling various kinds of farm or vegetable produce, applicable also to the crushing and grinding of minerals and other hard substances."—Petition recorded December 30, 1863.

Notices to Proceed.

2141. Walter Weldon, Falcon Court, Fleet Street, London, "Improvements in apparatus for aërial navigation."—Petitions recorded August 29, 1863.

2582. Nathaniel Fortescue Taylor, Manley Street, Stratford, Essex, "Improvements in increasing the illuminating power of coal gas, and in the means or apparatus employed therein."—Petition recorded October 21, 1863.

2677. John Robert Johnson, Red Lion Square, London, "Improvements in the manufacture of lubricating compounds."—Petition recorded October 26, 1863.

MISCELLANEOUS.

CHEMICAL SOCIETY.

The following arrangements have been made for lectures to be delivered at the Chemical Society during the present session:—

March 17.—"On the Organic Peroxides Theoretically Considered," by Sir B. C. Brodie, Bart., F.R.S.

April 21.—"On the Philosophy of British Agriculture," by J. T. Way, Esq.

May 5.—"On the Atomic Weights of the Metals," by Wm. Odling, M.B., F.R.S.

June 2.—"On the Recognition of Bodies by their Optical Properties," by Professor Stokes, M.A., Sec. R.S.

British Pharmacopœia.—We are informed that the smaller and cheaper edition of the Pharmacopœia will not be ready for another month. There must be some good tradesmen on the Medical Council.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"On Mordenite." By Dr. How.

Royal Institution.—Monday, February 1, at two o'clock, general monthly meeting. Tuesday, February 2, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Thursday, February 4, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Friday, February 5, at eight o'clock, J. A. Froude, Esq., "On the Science of History." Saturday, February 6, at three o'clock, John Lubbock, Esq., F.R.S., "On the Antiquity of Man."

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

Erratum.—Vol. ix., p. 7, *for* "Sorby," *read* "Daubrée."

J. P. A.—Impossible in the present state of our knowledge.

J. G. P.—The addresses of patentees are given in the printed specifications.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Synthesis of Propylene, by MM. Alexeyeff *and* F. Beilstein.[*]

Bromoform dropped upon cooled zinc ethyl produced a lively reaction. The volatile products were entirely absorbed by bromine. This solution treated with caustic soda yielded an oil boiling about 142° C., which had the composition and properties of bromide of propylene. A small quantity of bromide of ethylene was formed at the same time by the disengagement of a little ethylene,—a secondary product in nearly all the reactions of zinc ethyl. Pure bromide of ethyl was left in the cooled tube. The following equation explains the reactions which take place:—

$$\text{Ȼ}\text{HBr}_3 + 2\text{Zn}\text{Ȼ}_2\text{H}_5 = \text{Ȼ}_3\text{H}_6 + \text{Ȼ}_2\text{H}_5\text{Br} + 2\text{ZnBr}.$$

The bromide of propylene obtained was treated with ethylate of soda, and the gas disengaged was passed into an ammoniacal solution of protochloride of copper. In this way the yellow allylide of copper was obtained. There can, therefore, be no doubt that the propylene formed synthetically by the union of the two radicals $\text{Ȼ}'''\text{H}$ and $\text{Ȼ}'_2\text{H}_5$ is identical with the propylene obtained by the ordinary means.

Iodoform appeared to combine with zinc ethyl, and yielded no gaseous products.

The authors could not succeed in forming ethylide of chromium.

On the Purification of Oxalic Acid, by M. Maumené.

The process given by some authors for the purification of pure oxalic acid is inaccurate. It is recommended to purify by successive crystallisations, replacing the mother liquors by distilled water. The last crystals, it is said, will be the most pure.

The contrary really happens. However little alkali the acid contains, the successive crystals become richer and richer in it, which is easily understood when the less solubility of the acid oxalates is considered.

M. Maumené dissolved a kilogramme of the ordinary acid in three litres of hot distilled water. The filtered solution deposited an abundance of very white crystals. Sixty-three grammes of these were dissolved in a litre of water, to make a standard solution of the acid. The weather was very cold, and the next day the author found crystals deposited. On calcination, 3·74 grammes of these dried crystals gave a residue of 0·64 KOCO_2, corresponding to nearly $\frac{1}{16}$th of their weight of quadroxalate of potash; 4·95 grammes of crystals obtained from the mother liquor of the latter yielded 0·047 KOCO_2, equal to $\frac{1}{105}$th of the total weight, or 1 of KO to 88 of C_2O_3.

It is thus evident that the first crystals are richest in alkali, and successive crystallisation from pure water does not affect the purification of the acid.

M. Maumené next examined the yellow mother liquor from the first crystals. This, on spontaneous evaporation, yielded a crop of beautiful crystals. 5·81 grammes of these gave, on calcination, only 0·010 of sulphate of lime, mixed with a little iron, and the residue had no action on reddened litmus. By a crystallisation from distilled water the purification was almost complete. 2·156 of well dried crystals gave only 0·002 of a non-alkaline residue.

The way to obtain pure oxalic acid, then, is to dissolve ordinary acid in sufficient water to give 10 or 20 per cent. of crystals, according to the impurity of the sample. The first crystals are rejected, and the mother liquor is evaporated to furnish a fresh crop, which, after two or three crystallisations, will be found quite free from alkaline oxalates.—*Comptes Rendus*, t. lviii., p. 173.

Easy Preparation of Zinc Ethyl, by MM. Alexeyeff *and* F. Beilstein.[*]

The authors employ zinc turnings with only a small quantity of zinc and sodium alloy. Zinc turnings alone do not give a satisfactory result; but on adding a few grammes of the powdered alloy to a mixture of them with iodide of ethyl, the reaction immediately begins, and once established, the turnings are attacked by the iodide of ethyl as easily as the alloy, and the process goes on with the same rapidity.

The authors employ the zinc turnings found in commerce, simply dried over sulphuric acid. For 100 grammes of iodide of ethyl they use seven or eight grammes of the alloy and seventy or eighty of zinc. The operation goes on very regularly, and the results are always in accordance with theory.

TECHNICAL CHEMISTRY.

Practical Observations on Soluble Glass. Extract by M. E. Kopp, *from a Memoir by M.* Ordway.

(Continued from vol. viii., page 296.)

The threshold of the charging and discharging doors should be on the same plane as the grate, and should very gradually slope to the general level of the sole. Were the doors not thus raised, the melted sulphate and incandescent glass would run out. M. Ordway uses a furnace, the surface of the sole of which measures 40 square feet (422 square decimetres), and the grate 11 square feet (116 square decimetres). The chimney is about 50 feet high, and the opening of the vaulted carneau conducting directly to it is 9 inches high by 20 inches broad. In such a furnace four charges may be made in twenty-four hours, burning about 5000 lbs. of Pictou coal; each charge is composed of 550 lbs. of white sand, from 600 to 700 lbs. of crude sulphate of soda, and from 70 to 90 lbs. of anthracite dust. It is best to determine beforehand the approximate amount of carbon to be employed. The amount of carbon required for two similar charges is not always equal, on account of the variety of accidental influences; for this reason a few pounds should be held in reserve, to be added or not, according to circumstances. When the charge is perfectly liquified, and all the sand has disappeared, if there is an excess of coal, the glass remains black; if there is no excess of coal, the mass takes gradually a pale tint,—as may be seen by now and then taking some out on an iron rod; and when stirred the sulphate separates from the pasty silicate as a clear liquid. One or two pounds of coal should then be thrown into the furnace and well stirred up. Under the influence of the disengagement of sulphurous acid, the mass puffs up, boils suddenly, and then again subsides. It may be necessary to add coal a second or even a third time. The operator requires practice and a certain amount of tact to stop at exactly the right moment. An excess of sulphate may be remedied, but an excess of coal not without difficulty. When the melted mass becomes

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[*] *Comptes Rendus*, t. lviii., p. 172.

[*] *Comptes Rendus*, t. lviii., p. 171.

sufficiently fluid, homogeneous, and clear-coloured, it may be decolorised by arseniate of soda, and withdrawn from the furnace. The fire-irons are changed as soon as they become too hot to offer sufficient resistance.

To prepare a solution of pasty or liquid silicate, some coarsely ground glass is boiled in water until the solution marks 25° B. = 1·208 p. sp.

If made much stronger, the solution does not easily clarify. Soluble glass is sometimes dissolved by passing the vapour directly into water, but, as the heat is insufficient, the solution is formed very slowly by this process. An iron cauldron, open-heated, is much preferable. The insoluble matters are left to deposit; then, observing, however, certain limits, the decanted and limpid liquid is reduced by evaporation to the different degrees desired. When the liquid thickens, heat should be very carefully applied; for, after a certain degree of concentration, the silicate adheres rapidly and closely to the cauldron; so that, to prevent the adhesion of a spongy matter, the bottom and sides must be incessantly scraped with an iron rod terminating in the form of scissors.

It would be absurd to try to evaporate to dryness. Sesquisilicate of soda can hardly be concentrated to more than 50° B. = 1·525 p. sp.

To obtain the comparatively most concentrated solution of silicate, the purest possible materials must be used for the soluble glass. Earthy or metallic oxides greatly diminish the solubility of the product; and if the slightest trace of them remains, a proportionally larger quantity of alkali is required to enable the mass to dissolve more readily in boiling water. A silicate thus alloyed will not wholly dissolve in water; indeed, when boiled with water, it decomposes into a more alkaline silicate, which dissolves, and into a voluminous quantity of earthy silicate remaining as residuum, —frequently in the form of wash, flakes, or scales. Thus, a soluble glass, well made in other respects, but manufactured with crude sulphate of soda, yields to water only 89 per cent., leaving a large insoluble sediment, composed of soda, lime, magnesia, alumen, ferrous and ferric oxides, and silicate. Common window glass is really only an alkaline silicate, rendered insoluble by containing a larger proportion of lime or oxide of lead. Fuchs himself insists on the necessity of employing sand free from lime and alumen. He says that a little iron is not hurtful, but this is true only when the glass remains brown or black, the iron being in a state of sulphide. Fuchs further states that insoluble glass cannot be made with pure potash and quartz; "for, if we take two parts of quartz for one of potash, we obtain—as I have ascertained—a glass which partly dissolves in water."

These proportions form a silicate, represented by $3KO,10SiO_3$. "It has long been known, as Scheele has proved, that even ordinary glass, containing lime, is more or less attacked by boiling water. I found that many varieties of glass, when crushed for a long time with water in an agate mortar, give a very sensibly alkaline reaction, and that, by boiling glass, reduced to a fine powder, in water for several hours, a liquid with alkaline reaction is obtained, giving, with sal-ammoniac, a flaky precipitate." M. Pelouze found that, by boiling for some time with water, some finely powdered white glass ($32SiO_3,11CaO,8NaO$), about 3 per cent. was dissolved. Another variety of glass, containing less lime ($13SiO_3,4NaO,2CaO$), abandoned 18·2 per cent. in boiling, and that which formed a solution was sesquisilicate of soda. M. Fresenius affirms that even a glass vessel in water, even for a short space of time, yields a ponderable quantity of its substance. A simple silicate of potash or soda, with three equivalents at most of acid for one of base, may, however, be considered as practically insoluble. M. Péligot finds that the so-called "alabaster glass" is composed almost entirely of silica and potash in proportions suitable to form the silicate ($5SiO_3,KO$), if the whole of the silica enters into combination. But in this glass part of the silica is merely mechanically mixed, thus producing the opacity of the glass. M. Hein has, however, found in "alabaster glass," besides silica and potash, 1·5 per cent. of lime, and 2·3 per cent. of phosphate of lime.

Analysis of Soluble Glass.—By reducing a silicate to small pieces or coarse powder, its degree of transparency shows whether or not it contains any foreign salts. A good product is clear, brilliant, and homogeneous; a badly prepared one appears opaque and resinous if it contains much sulphide or chloride, the mass is spotted, cloudy, or quite opaque. To give soluble glass a milky appearance, it needs even less than 10 per cents of a mixture of saline matters.

The real value of the glass can be determined only by chemical examination; and, as analysis is subject to error, some necessary precautions may here be indicated.

In the case of a solid and dry glass, special care must be taken to effect the solution of all that water is capable of dissolving, a not very easy task, and one requiring both time and trouble. To determine the quantity of alkali, take for analysis an average specimen, and pound a certain quantity very finely in a hard-baked earthen mortar, and pound a certain quantity into very fine powder, but pulverise only one gramme at a time, and take care to avoid all moisture. Then weigh not more than five grammes of the porphyrised substance, and boil them for some time in a porcelain capsule, with from forty to fifty times their weight of water. The boiling should be continued, according to circumstances, during from fifteen minutes to an hour and a-half. To avoid violent sputterings, the mixture which has been heated should be stirred briskly and without intermission. When no uncombined sand is found in the matter treated, the heating may be discontinued, when the stirring-rod no longer encounters particles of sand. Fifteen minutes boiling is amply sufficient for a well-melted sesquisilicate of soda. The presence in a sample of uncombined sand causes uncertainty as to the necessary length of time. If, after an hour's boiling, a sandy residue remains, the operation should be stopped, and the material submitted to a preliminary analysis. If less than 28 per cent. of alkali is present, it is better to recommence the boiling for at least an hour and a-half.

When the solution is complete, add sufficient boiling water to make up a given weight (about forty times the weight of the dry silicate), then cover it and leave it to get cold. After decanting the greater part of the liquid, without disturbing the sediment, weigh a certain quantity of the solution, in proportion to the whole, and test it by the ordinary alkalimetric methods. It is both tiresome and useless to filter; for, though the decanted liquid is seldom perfectly clear, even after long standing, the earthy matter in suspension is too inconsiderable to exercise any sensible influence on the exactitude of the result. If the soluble glass is already in a liquid or pasty state, it should be well mixed with water before being tested, as a concentrated or hot solution is apt to gelatinise before all the acid has been added; it is then impossible to obtain an exact result, as acid afterwards added cannot easily penetrate this thick jelly. Thus, when the liquid operated upon becomes gelatinous, a fresh experiment must be commenced with a weaker and colder solution.

If sulphuric acid has been employed, the liquid which has been tested can be evaporated at the close of the operation; the silica will then be found in the form of a coarse, granular powder, easily washed, collected, incinerated, and weighed. Were the silicate precipitated by an ammoniacal salt, the residuum would probably be very voluminous, and so fine and light as to require the greatest care during calcination, to prevent its being partly blown away.

An excess of nitric or hydrochloric acid added to greatly diluted soluble glass, produces, for a long time, no apparent change; and in a weak solution treated in this way, sulphates or chlorides of iron or arsenic may be searched for without previously separating the silica. In the quantitative determination of sulphates and chlorides, it is better to treat the solution of silicate by an excess of nitrate of ammonia instead of by an acid; the loss of chlorine during the evaporation to dryness is thus avoided.

The presence of sulphides in a liquid soluble glass is determined by throwing into it a small piece of sulphate or carbonate of lead, which, in this case, rapidly blackens.

In determining the proportion of water in a liquid silicate, the solution should never itself be evaporated, for it becomes transformed into a bulky, spongy mass, difficult, or rather impossible to manipulate. This is obviated by previously mixing with the solution a given quantity of freshly calcined lime, of which the weight should be at least double that of the alkali supposed to be contained in the silicate. A few moments after this addition a double decomposition commences, and the glutinous nature of the silicate is destroyed. The whole turns into a friable mass, and, while the water may be evaporated with the greatest ease, all the other substances are retained. A mechanical operation is necessary to determine the proportion of uncombined and pulverulent sand, since all soluble glass holds in combination more or less of these earthy silicates, which remain after the solution in the form of a light sediment. To effect their separation take a certain quantity of coarsely-ground silicate, boil it with water until all that is soluble is dissolved, stir the whole thoroughly, allow it to stand a few moments, then decant, and the decanted liquid will take with it all the silicates held in suspension. After one or two washings in this way, the sandy residuum remaining will represent with sufficient exactness the proportion of uncombined silica. —*Moniteur Scientifique*, vol. xx., p. 63.

On the " Weather-Glass " of Galileo,

by George F. Rodwell, *F.C.S.*

In the *Athenæum* for July 26, 1862, the following letter, from a Mr. Thomas Zuiller, appeared :—

" **A Rain-Glass.**—The following may be depended upon as a rain-glass. I have used it for months. Get a common pickle-bottle, such as is sold at every Italian warehouse; fill it with any kind of water, to within two or three inches of the top; plunge the neck of an empty Florence oil-flask into the pickle-bottle. Before rain the water will rise two or three inches in the neck of the inverted flask—often in three or four hours. If the weather is settled for fair, the water will remain not more than half an inch high for days in the neck of the flask. It never fails to foretell rain; and to-day, July 15, rose as high as the rim of the pickle-bottle in the neck of the flask. It may stand in or out of doors, in sun or shade, and the water never needs changing so long as it can be seen through."

A number of letters were afterwards published in the *Athenæum*, the *Field*, and several other papers, relative to this rain-glass, in most of which the writers stated that they invariably found the water rise for fine weather, and fall when rain might be expected—an exactly contrary effect to that observed by Mr. Zuiller.

This " rain-glass " is but a modified and clumsily constructed form of Galileo's air-thermometer, invented more than 260 years ago. It is quite obvious that such a weather-glass can give no reliable results as to the weather from the great extent to which it is affected by the temperature of the air. If the temperature were tolerably constant, a rise of the barometer would cause the water to rise in the neck of the flask; but I do not wonder at Mr. Zuiller finding the water fall for fair weather, after his statement, that the rain-glass may " stand in or out of doors, *in sun or shade.*"

An increase of the pressure of the air would, of course, cause the water to ascend, but the ascent would constantly be entirely counterbalanced by the depression due to increase of temperature; so that it might often happen, with a high barometer, and a certain temperature, the water would be lower than with a low barometer and a lower temperature.

In order to gain some idea of the indication which such a barometer as Mr. Zuiller describes would give of the pressure of the air, a Florence flask of the ordinary size, the contents of which were 363 cubic centimetres, and the neck of which had a tolerably uniform diameter of $\frac{5}{8}$ths of an inch, was inverted, and its neck plunged into water, as described in the letter given above. It was placed in the open air, and protected from the sun, and its indications, during a fortnight, compared with those of a mercurial barometer. 1° F. diminution of temperature caused the water to rise in the neck of the flask about ·07 inch, and a rise of 1 inch of the mercury column caused the water to ascend $1\frac{3}{4}$ inch when the effect due to temperature was withdrawn. Thus, a decrease of temperature of 25° F. produced the same effect as the increase of pressure represented by 1 inch rise of the mercury column.

About the beginning of this century, Mr. Alexander Adie invented a very ingenious form of air-thermometer, which could be applied to the measurement of the pressure of the air, and which furnished accurate results. This instrument, known as the sympiesometer (from *συμπειζω*, to compress; and *μετρον*, a measure), consists of a glass tube, terminated above by a bulb filled with hydrogen; the lower end of the tube is curved, and communicates freely with the air, and the tube contains oil or glycerine, by the rise or fall of which the pressure of the air is indicated. As near to the bulb as possible, there is a mercurial thermometer, and the temperature must be read off at the time of making each observation; and by means of a movable scale attached to the instrument, we learn the pressure of the air in inches of mercury, which has produced the change in the height of the oil column, when the effect due to increase or diminution of temperature has been withdrawn. By means of this instrument Mr. Adie found the height of Arthur's Seat to be 114·85 fathoms, the actual height being 114·17 fathoms.

The air-thermometer served the purpose both of weather-glass and of thermometer from the time of its invention until the discovery of the barometer by Torricelli, and the invention of the spirit-thermometer by the Florentine Academicians; it was used by Galileo by Bacon, by all the philosophers of the first half of the 17th century. Such being the case, it was thought to be of some interest to determine the indications relative to the weather afforded by an instrument such as was used by these early philosophers, and to examine to what extent it is affected by the pressure of the air.

The instrument as used by the 17th century philosophers is generally described as consisting of a vertical glass tube $2\frac{1}{2}$ or 3 feet long, and "as narrow as a straw," terminated above by a bulb, "about the bigness of a hen's egg;" the lower open end of the tube dipped into a vessel of water, and, by the expulsion of a small quantity of air, water was caused to rise 9 or 10 inches in the stem of the instrument.

The tube used in the following experiments had a diameter of $\frac{1}{16}$th of an inch, and was 2 feet 11 inches long; the bulb was nearly 2 inches diameter, and contained 68 cubic centimetres of air at 48° F. The open end of the tube was placed in a vessel of water, and water caused to ascend in the stem. The water stood 12 inches above that in the vessel below, when the temperature was 44° F., and the height of the barometer 28·975 inches; this was taken as a zero point. The instrument was placed in the open air, near the angle formed by two walls, and the bulb was protected from the sun.

An increase of the pressure of the air, and a simultaneous diminution of temperature, will cause the water to ascend in the stem of such an instrument for the following reasons:—(1) The tension of the outer air will be greater than that of the air within the bulb; (2) the air within the bulb will be contracted by the diminution of temperature; (3) the tension of the aqueous vapour within the bulb will be diminished; (4) the increase of pressure and diminution of temperature will both cause more air to be absorbed by the water within the instrument. Similarly, rise of temperature and simultaneous fall of the barometer will cause depression of the column of water, because the tension of the outer air will be less than that of the air within the bulb; the air within the bulb will be expanded by the increase of temperature; the tension of the aqueous vapour within the bulb will be increased; and less air than before will be absorbed by the water within the instrument.

Increase of temperature and simultaneous increase of pressure will, therefore, give a rise or fall of the water column expressed by the rise caused by increased pressure − the depression due to increase of temperature − the depression due to increased tension of the aqueous vapour ± the elevation or depression caused by the diminished or increased absorption by water of the air within the instrument, which will depend on the relation between the increase of pressure and the increase of temperature, because the former will cause a greater absorption, and the latter a less absorption than before.

1° F. diminution of temperature was found to cause the column of water to ascend ·582 inch, and 1 inch rise of the mercury column caused an ascent of about 8·1 inches, when the correction due to temperature was made; thus 13·91° F. diminution of temperature produced the same effect as 1 inch rise of the barometer.

The effect produced by 1° F. being known, the reduction to the same temperature could obviously be readily effected. As previously stated, the height of the column at 44° F., with the barometer at 28·975 inches, was taken as zero; when the temperature of the air was 50·6° F., and the barometer at 30·23 inches, the column of water was found to be 6·125 inches above zero; required the actual rise of the water column due to increase of the pressure of the air. The increase of temperature above the zero is 50·6-44° F. = 6·6 F.; and as 1° increase depresses the column ·582 inch, the depression due to temperature will be 6·6 × ·582 = 3·841 inches, 6·125 + 3·841 = 9·966, the rise due to increase of pressure alone.

Mr. Glaisher has kindly furnished me with the height of the barometer at the time at which each observation of the air thermometer was made; and the following table shows the height of the water column above the zero point, at the different heights of the barometer, by which it will be seen that about 8·1 inches rise in the stem of an air thermometer, possessing a bulb of such capacity, and a tube of such diameter as that previously described, is caused by a rise of 1 inch of mercury in the barometer:—

I. Height of the Barometer.	II. Actual Ascent of the Water Column in Inches, produced by Increase of Pressure, the effect due to Temperature being withdrawn.	III. Increase of Pressure in Inches of Mercury, producing the Ascent of the Water Column.
28·975	—	—
29·138	1·640	·163
29·328	2·172	·353
29·675	5·453	·700
29·742	6·410	·767
29·750	6·590	·775
29·845	6·849	·870
29·907	7·351	·932
29·974	8·099	·999
29·988	8·367	1·013
30·020	8·203	1·045
30·185	9·746	1·210
30·230	9·966	1·255
30·311	10·595	1·336
30·317	11·170	1·342

These results are of no scientific interest. I was induced to make the experiments detailed above on account of Boyle's statement, mentioned in a previous number,* and my sole object has been to gain some idea of the indications relative to the weather, which were afforded by the air thermometer to the philosophers of the first half of the 17th century.

PHARMACY, TOXICOLOGY, &c.

On Oxycinchonia, an Alkaloid Isomeric with Quinia, by M. Strecker.

The interesting relations which exist between quinia and cinchonia, as much in regard to composition as to origin and properties, have suggested to M. Strecker the idea of seeking to fix on cinchonia the oxygen necessary to make its composition that of quinia. He has succeeded; but the product is not quinia, only an isomer of that base.

The transformation has been effected by the aid of a well-known process, which consists in replacing one eq. H by Cl, Br or I, and afterwards replacing this metalloid by HO, by means of potassa or hydrated oxide of silver.

Monobrominated cinchonia of Laurent is boiled with water and an alcoholic solution of potassa. After a prolonged ebullition, a current of CO_2 is passed into it to neutralise the alkali. After evaporation to dryness, it is washed with water, and the residue treated with boiling alcohol, which deposits, by evaporation, colourless crystalline plates of the composition $C_{40}H_{24}N_2O_4$.

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* See "On the Supposed Nature of Air prior to the Discovery of Oxygen," No. 5, Exp. 18, in the last number of this Journal.

This is the formula for quinia, but it has not the properties of that base. The solutions are not fluorescent, like those of quinia, nor do they yield dalleochin by chlorine and ammonia. Its salts are with difficulty crystallisable; the most crystallisable being the neutral sulphate and oxalate.

The author has named the new base *Oxycinchonia.*—*Jour. de Pharm.*

The British Pharmacopœia.

I.—The Novelties in the Pharmacopœia.

(*Continued from page* 54.)

By an inadvertence, the word *tersulphuret* was written last week for *oxysulphuret*. *Antimonium sulphuratum* is the new name for the oxysulphuret of the last Pharmacopœia.

We now proceed with the novelties.

Ferri Arsenias, arseniate of iron, has had a very limited use as a medicine. It is prepared by the double decomposition of arseniate of soda and sulphate of iron. The precipitated arseniate of iron is well washed, and then squeezed in a strong press, and afterwards dried at a temperature not higher than 100° F.

Ferri et Quiniæ Citras, citrate of iron and quinine, is now an officinal preparation. Elaborate directions are given for the preparation of this compound, but, if they are followed, we very much doubt whether anything like the elegant and soluble compound well known in commerce will be obtained. It contains 16 per cent. of quinia.

Ferri Oxidum Magneticum, black magnetic oxide of iron, is a compound from the last Edinburgh Pharmacopœia, but will be remembered by older pharmaceutists as having had considerable use in England years ago. It is a mixed precipitate of the per- and protoxide of iron, which requires no further notice.

Ferri Perchloridi Liquor, solution of perchloride of iron, is used in the preparation of the tinctura ferri perchloridi, which is to replace the former tinctura ferri sesquichloridi. It is made by dissolving two ounces of iron wire in ten fluid ounces of hydrochloric acid diluted with five fluid ounces of water. This solution is peroxidised by the addition of six fluid drachms of nitric acid, and then evaporated to ten fluid ounces. To make the tinctura ferri perchloridi, five fluid ounces of the solution are added to fifteen fluid ounces of rectified spirit. A fluid drachm of the solution will contain 15·62 grains of peroxide, and a fluid drachm of the tincture, therefore, a little less than four grains.

Ferri Pernitratis Liquor, solution of pernitrate of iron. This preparation has been a good deal prescribed for diarrhœa, and now finds its place in the Pharmacopœia. It is made by dissolving an ounce of iron wire in three ounces of nitric acid properly diluted, and afterwards making up the solution to a pint and a-half. A fluid drachm, precipitated by ammonia, should yield 2·6 grains of peroxide.

Ferri Peroxidum Hydratum, hydrated peroxide of iron, is esteemed an antidote in cases of poisoning by arsenic. It must, however, be recently prepared. It is made by precipitating a solution of persulphate of iron with an alkali. As it may be urgently required at any moment, pharmaceutists should keep a solution of the persulphate in readiness.

Ferri Phosphas, phosphate of iron, is a salt which probably every druggist has in his stock, so needs no further notice.

Ferri Sulphas Granulata, granulated sulphate of iron, is not granulated in the now common acceptation of that word. It is here directed to be made by dissolving iron wire in diluted sulphuric acid, and filtering the solution into rectified spirit, whereupon the salt is obtained in minute granular crystals. It could, of course, be made by dissolving the ordinary sulphate of iron in water with a small quantity of sulphuric acid, and filtering that solution into alcohol. Sulphate of iron in this state is not so susceptible to the influences of air and moisture.

Ferri Sulphas Exsiccata, dried sulphate of iron, we dare say, every dispensing chemist has long kept for his own convenience, although the use was not quite justified.

Ferrum Redactum, reduced iron, Quevenne's iron, as it has been called, is iron reduced as far as possible to a metallic state by passing a stream of dry hydrogen gas over the peroxide of iron heated to redness. The article sold under the name is of very variable quality, but, according to the Pharmacopœia, it ought to contain at least half its weight of metallic iron.

Ferrum Tartaratum is the new name for the potassio-tartrate of iron of the London, and ferrum tartarizatum of the Edinburgh and Dublin Colleges. The new name looks like a compromise between the three learned bodies. We would have preferred to retain the old, though somewhat long name, since it expresses the composition of the salt.

Filix, fern root, is now introduced with the ethereal extract well known for a long time in pharmacy.

Glycerinum, glycerine, is naturally added to the Pharmacopœia. It must be with colour and odour, and have the specific gravity 1·26.

Hemidesmus, the root of the *Hemidesmus indicus*, introduced some years ago as a cheap substitute for sarsaparilla, has for some reason or other been added, and a syrup is directed to be prepared. Four ounces of the bruised root are to be infused with a pint of boiling water for four hours, and twenty-eight ounces of sugar are to be dissolved in the strained liquor.

Hydrargyri Nitrates Liquor Acidus, an acid solution of nitrate of mercury now ordered separately for the preparation of the unguentum hydrargyri nitratis; although, when the ointment is referred to, a solution of a totally different sort is seen to be required. The materia medica, and the preparations and compounds of the Pharmacopœia, were evidently sent through the press by different hands.

The acid solution of nitrate of mercury is used as an escharotic by some obstetric physicians, and is sometimes applied to carbuncles. It is to be made by dissolving four ounces of mercury in three fluid ounces and a quarter of nitric acid diluted with three fluid ounces of water. After the mercury is dissolved the solution is to be boiled gently for fifteen minutes.

Kamela.—The present Pharmacopœia is rich in vermifuges, and it will not be for want of a choice of remedies if a single tape-worm is left in a human body. Kamela is no doubt well known to most pharmaceutists as the powder adhering to the capsules of the *Rottleria tinctoria*, and calls for no remark, except that, as stated here, in order to be genuine the greater part should be soluble in ether.

Laurocerasus, a water distilled from cherry laurel leaves, is introduced from the Dublin and Edinburgh Pharmacopœias. A pound of the crushed fresh leaves are to be macerated with two pints and a-half of water for twenty-four hours, and then a pint is to be distilled. The water, however, will always be of an uncertain strength.

Lithiæ Carbonas, Lithiæ Citras.—The carbonate and citrate of lithia. These salts call for no observation.

Magnesia and *Magnesia Levis* are the light and heavy calcined magnesia. The former is used in the making of Gregory's powder, now a Pharmacopœia preparation under the name of Pulvis Rhei Compositus.

Magnesiæ Carbonas and *Magnesiæ Carbonas Levis* are the light heavy carbonates, the processes for making which we shall notice at a future time.

Matica matico.—Only an infusion is ordered. Half an ounce of matico, cut small, is infused for half an hour in half a pint of boiling water.

Nectandra.—Bebeeru bark is employed to furnish the sulphate of beberine.

Oleam Coriandri.—Oil of coriander has been placed among the materia medica, for what reason we do not know, since we have not been able to discover any preparation in which it is used.

Oleum Myristicæ.—The volatile oil of nutmeg is now employed in making the spiritus myristicæ, and also in spt. ammoniæ aromaticus.

PHYSICAL SCIENCE.

On the Spectrum of Lightning.

M. Louis Grandeau has published at Mallet Bacheliers an excellent work, entitled "Practical Instruction in Spectrum Analysis," which will be useful to chemists desirous of becoming familiar with the details of this new method of optico-chemical analysis. M. Grandeau gives a description of the principal appearances which have been notified by the researches on the spectrum, and explains how they are to be obtained; two plates upon copper and one chromo-lithograph are given, representing the spectroscope, Geissler's tubes, the spectra of the metals, &c.

We quote a very interesting observation which M. Grandeau himself made, and which relates to the spectrum of nitrogen. In the night of August 13, 1862, this chemist made some researches with a single prism spectroscope upon the lightning which burst at close intervals in the dense clouds in front of his laboratory. He arranged the experiment so that the lightning illuminated the free half of the slit of the collimator, whilst the tube of nitrogen sent its light obliquely into the part of the slit covered by the total reflexion prism. A small quantity of the vapour of water remained in the nitrogen tube at the time it was prepared, sufficient to produce very neatly the characteristic rays of hydrogen superposed on the nitrogen rays. M. Grandeau was able during an hour, at intervals of five minutes, to observe the spectrum of the lightning, the general appearance of which recalled at first sight that of the electric spark; but on closer observation, M. Grandeau soon noticed in the spectrum of almost every flash the coincidence of a certain number of the rays of this spectrum with those of the spectra of nitrogen and hydrogen. M. Grandeau remarks that this result is not to be surprised at, since all admit the production of ammonia and nitric acid under the influence of electrical discharges. Besides the rays of nitrogen and hydrogen, M. Grandeau proves that the lightning spectrum contains the yellow ray of sodium. This observation is, we think, the first application of spectrum analysis to the study of the electric discharge from the clouds.

Apropos of lightning, we remember that M. Andrès Poey intended to study the notes contained in the noise of thunder by means of the tuning forks of Helmholtz, constructed by M. Kœnig, but we do not know if he has followed up his project.—*Moniteur Scientifique.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IV.—*Saturday, December 19, 1863.*

(*Continued from page 57.*)

Before proceeding to consider this grand subject of dolomite, which is a great *questio vexata* of geologists, let me direct your attention for a few moments to some of the mineral species occurring in nature. We have, first of all, pure dolomite; that is, a compound of one equivalent of carbonate of magnesia, and one equivalent of carbonate of lime—equivalent to equivalent exactly. It contains exactly 47·83 per cent. of carbonic acid; of lime, 30·43 per cent.; and of magnesia, 21·74 per cent. This may occur not only distinctly crystallised, but granular crystalline, constituting another variety of this mineral, the composition of which, however, is the same. Then we have several other varieties. We have one consisting, for example, of three equivalents of carbonate of lime and two of carbonate of magnesia; then we have another, consisting of two equivalents of carbonate of lime and one of carbonate of magnesia, occurring in Styria and in the Tyrol. There is another, consisting of one equivalent of carbonate of lime and three of carbonate of magnesia; and we have other varieties in which the magnesia is partially replaced by carbonate of iron, constituting brown spar—carbonate of iron and carbonate of magnesia.

The term dolomite, or magnesian limestone, is applied to that substance which consists essentially of carbonate of lime and carbonate of magnesia, and which, when pure, is composed, as I have said, of one equivalent of each. Of this dolomite there are several varieties, and I will give you the following classification, founded upon Senfft's book and also Coquand's. Senfft's is the best, and it is rather surprising to me that so capital a book should not yet have appeared in an English dress. I hardly know any work which would be more useful to geologists than that book, which is written in German. We have there the several varieties, founded upon structure. First of all, we have the granular variety of dolomite. It has a crystalline or saccharoidal, or sugar-like crystalline structure, and it often consists of small, distinct, rhombohedral crystals. Then we have what is properly called the compact variety, which is stone-like in appearance, and may even present a more or less conchoidal fracture. We have another variety, exceedingly porous—if I may apply the expression "porous" to this variety—called the cellular. It is yellowish, or smoke-grey, in colour (rauchgelb,—German), and remarkably fissured in all directions. There is a variety classified as the schistose, or slatey, which occurs in the Jura. Lastly, we have an earthy variety, which is friable and pulverizable. These are all the varieties founded simply upon external characters.

We have other varieties founded upon differences in composition. First, there is the calcareous, that is, the dolomite, which contains more carbonate of lime than is indicated by the formula I have given—dolomite associated with an excess of carbonate of lime. Then there is the siliceous, which contains sand. Lastly, there is the argillaceous, which contains clay in admixture.

With regard to the calcareous dolomite, how do we know that it is dolomite mixed with an excess of carbonate of lime? Why, in this way. If you take that dolomite and reduce it to powder, and act upon it by very weak acetic acid, the carbonate of lime in excess alone will dissolve. Scarcely a trace of the dolomite will be attacked, and there will remain behind, after you have removed all that is capable of being separated by acetic acid, a product having the chemical composition of dolomite. You could not desire, I think, any stronger proof of the fact than this. Dolomite generally, or frequently, is exceedingly free from associated foreign matters, but there are varieties which contain a considerable amount of impurity. One is mentioned in Brazil, in which is found 14 per cent. of quartz mixed with mica; but, as a general rule, it may be considered as a very pure rock, that is, comparatively. Dolomite occurs in nature massive—in great masses apparently—really without any evidence of stratification. It occurs again in regular, distinctly stratified rocks.

Upon these points great questions hang. Dolomite, in some localities—as in the Tyrol—is red and fissured in a most remarkable way, and the possible cause of this we shall have by-and-by to consider. We find, or geologists rather, find in certain localities distinct evidence of the fact, that a limestone bed passes by imperceptible gradations into dolomite. With limestone, there is distinct evidence, I suppose, of stratification in one part; and the other, not distinct, in the same continuous body, shall be converted into unmistakable apparently non-stratified dolomite. That is an important fact to bear in mind. With regard to the mode of formation of dolomite in nature, it is a great problem, one which has excited vast attention, and one which, I am sorry to say, is far from yet being solved in a satisfactory manner. Still, I think we know a great deal more than we did upon the subject, and we know that certain theories which were propounded not many years ago, and which were accepted by geologists as correct, are wholly untenable, so that we get rid of a certain amount of error.

Now, the question is, has dolomite been deposited as such? Is there any case in which we find dolomite, and have reason to believe it has been thrown down, deposited as we find it; or has dolomite resulted from metamorphic action?—that is to say, had it originally a different appearance and different nature altogether, and has it subsequently been generated by what geologists term metamorphic action; or has it been formed by both these methods? I shal proceed to examine these points. I have endeavoured to collect together from various sources all the information upon the subject, and to present it to you in a condensed and available form. I repeat, many interesting problems in connexion with this subject yet remain to be solved. Now, dolomite is found not unfrequently—nay, frequently—associated with gypsum. Hence it was inferred by Haidinger, that dolomite was produced by the action of a solution of sulphate of magnesia on carbonate of lime. Carbonate of lime abounds, we know, in nature, and so does sulphate of magnesia. If we can only bring these things together, we shall have no difficulty whatever in producing dolomite, according to Haidinger, the products being gypsum and dolomite. But we must ask ourselves the question, Suppose we bring a solution of sulphate of lime in contact with carbonate of lime, chalk, will dolomite be formed? At the ordinary temperature, undoubtedly not, but quite the reverse; for when a solution of gypsum percolates through pounded dolomite, this is wholly converted into carbonate of lime, with the formation of sulphate of magnesia,—the very reverse of what was supposed according to theory. Therefore it is perfectly clear that, at the ordinary temperature, Haidinger's theory is wholly untenable. He supposed the case might be different at a high temperature. Accordingly experiments were made upon the subject; and it was shown that a mixture of crystallised sulphate of magnesia and pounded calc spar, in the proportions of one equivalent of the former to two of the latter, when heated in a sealed glass tube, was completely changed into dolomite and sulphate of lime—so completely, that no trace, even of sulphate of magnesia, remained. Here, then, we find that, by the application of heat, an opposite result takes place. But, then, how are we to account for this generation of heat at the bottom of the ocean bed? How is the water to exist at a high temperature? It requires a very high temperature—400° Fahrenheit, 200° centigrade, or thereabouts—in order to effect this change; and if the bottom of the sea be so hot as this, surely there ought also to be a very high temperature above. According to Bischoff, the whole sea ought to have been boiling when this condition obtained. He rather naïvely remarks that, at 17,600 feet, the temperature of the water of the ocean would be 392°, or just that degree at which this change was found to take place in the formation of dolomite, if, as he says, the temperature did not happen to decrease with the depth. Hence, unless Haidinger can show reason for the existence of such a temperature, dolomite, he maintains, could not be formed; and I think that is a very fair way of stating the case. Moreover, if the dolomite of the Tyrol had been thus formed by the reciprocal decomposition of these two salts, he thinks, and I think, properly, that we ought to have found in the vicinity large masses of gypsum, which is not the case. Still, that is an argument which may be open to objection, I admit. Now, bearing upon this point, I will mention to you a curious process which is not publicly known, which I saw in operation about thirty years ago, in Nottingham—a process for making sulphate of magnesia; and it possibly may help on geologists in their consideration of this subject. I saw myself tons of sulphate of magnesia produced in the manner I am about to describe. The process was invented by a Mr. Grisenthwaite; a man who wrote one or two curious books—one a very interesting book, certainly before its day, upon agricultural problems, especially specific manures, in which he pointed out most clearly, and in most unmistakable terms, one of the great points which has been so lucidly and forcibly described by Liebig, long afterwards. He took gypsum and ground it to powder; he took dolomite, calcined that, and ground it to powder likewise. He got then sulphate of lime and caustic magnesia; for, during the calcination, the magnesia was rendered caustic, and the lime was only partially deprived of carbonic acid. He got then, practically, sulphate of lime, caustic magnesia—that is, magnesia deprived of carbonic acid—and carbonate of lime; he put this mixture into large tanks filled with water, and passed through that water a current of carbonic acid, and he produced sulphate of magnesia by the ton. The sulphate of lime dissolves; it is soluble in water. Then you have magnesia and carbonic acid. There is the affinity of the magnesia for the sulphuric acid of the sulphate of lime, and the affinity of the carbonic acid for the lime, which is pretty strong, especially from its producing an insoluble compound, carbonate of lime, and, by virtue of this double affinity, that change was effected, and sulphate of magnesia was formed. Sulphate of lime was decomposed by the joint action of this caustic magnesia, and carbonic acid. I merely mention this fact *en passant.* It may possibly be found interesting. Now, there is the view of Elie de Beaumont, who computed that when one of two equivalents of carbonate of lime is replaced by carbonate of magnesia, owing to the higher specific gravity of the whole and the lower atomic weight of magnesia, there would remain 12 per cent. of hollow space. Well, then, an examination was made, and the result was arrived at from an examination of one specimen—we do not find more—that the amount of interstitial space left was 12·97 per cent. This is a very near approximation, but who would think of founding anything like a theory on a single fact of this kind, which may be a coincidence, for aught we can tell? It is only on repeated experiments, made with infinite care, that we are justified in basing a grand theory on a subject of this kind. A single fact of this kind ought, I think, to be ignored.

We next come to some very important information, or rather experiments, made by Dand, which, to my mind, are exceedingly conclusive so far as they go. His experiments establish the fact, I think unmistakably, that dolomite may be, and is, produced, at all events in certain conditions, by direct aqueous action. In fresh corals he found less than 1 per cent of magnesia, but in compact coralline limestone he found 38 per cent. of carbonate of magnesia. Another rock, consisting of the remains of corals, gave upwards of 5 per cent. There was no indication, he says, of the action of heat. Assuming—and I think it is an assumption which every one would be prepared to make, now-a-days at all events—that the ancient corals were composed like those of modern species, it follows that the magnesia must have been added to these ancient coralline remains, and that could only have arisen from the action of water containing magnesian salts upon the carbonate of lime of the corals, whereby a portion of carbonate of lime is removed and replaced by an equivalent amount of carbonate of magnesia. To my mind, I think that argument is perfectly unanswerable as far as it goes. We find another theory put forth by Sandberger, which explains the formation of the dolomite in Nassau by the action of water charged with carbonic acid upon a black limestone, rich in magnesia. A portion of the lime was supposed to be thus carried away, leaving dolomite, which, as we have seen, is less easily soluble in acid solutions than carbonate of lime itself. The carbonate of lime was again deposited in fissures in the rock as calc sinter or calc spar. Now, let us see whether this is established in any way by experiment. We find some experiments recorded by Bischoff which bear upon it, and which show that carbonic acid dissolved in water acts upon dolomite, containing an excess of carbonate of lime, exactly as the acetic acid does, that is to say, removes the excess of carbonate of lime, leaving dolomite. I will cite the results of two experiments of Bischoff upon carbonate of lime containing carbonate of magnesia. In one the carbonate contained 98·22 per cent. of carbonate of lime and 1·32 per cent. of carbonate of magnesia; and in the other 84·57 per cent. of carbonate of lime and 11·54 of carbonate of magnesia. The carbonate was finely pounded, and mixed with water, and carbonic acid was passed through for twenty-four hours. The solutions were filtered and evaporated to dryness. The first residue contained of carbonate of lime, 2·93, and of carbonate of magnesia, only a trace, showing that none had been removed, or no appreciable amount, by the solvent action of carbonic acid in water, whereas the lime had been removed in large quantities. The second contained 4·29 carbonate of lime and no trace of magnesia; so that I think that point is clearly made out by experiment. Hence it is inferred that by the action of surface-water or sea-water on limestone containing magnesia, the excess carbonate of lime would be removed, and at last only dolomite would remain.

There is another theory put forth by Nauck, that water charged with carbonic acid decomposed the silicates, and deposited the dissolved matters, magnesia and silica, in other places. Silicate of magnesia I refer to especially. This silicate of magnesia thus dissolved by atmospheric water percolates through carbonate of lime, leaves the silica, and combines with a portion of carbonate of lime to form dolomite; carbonic acid here playing evidently an important part. This silica, it was supposed, was deposited in fissures or cavities as quartz or opal.

We next come to another supposition as to the mode of formation of dolomite. Two geological observers, Favre and Marignac, supposed the dolomite of the Tyrol to have been deposited, and not to have been metamorphosed. They supposed that volcanic eruptions occur, attended with the evolution of sulphurous acid, that is, the same acid that is produced when sulphur burns in the open air, and by the action of this acid upon augitic tufa, thrown out and spread over the sea-bottom, sulphite of magnesia was formed; that this sulphite became converted into sulphate (this implies the presence of oxygen necessarily); also that there may have been, as we know may be the case, certain volcanic emanations of hydrochloric acid, by the action of which upon this tufa, chloride of magnesium may have formed. They found that by heating carbonate of lime and chloride of magnesium in a closed glass tube to 200° centigrade during six hours, a precipitate was produced containing 48 per cent. of carbonate of lime, and 52 per cent. of carbonate of magnesia, or substantially, dolomite.

This theory involves the necessity of supposing that oxygen must have been present at great depths to oxidise the sulphite of magnesia, and that a comparatively high temperature existed at the bottom of the ocean. We have already considered this part of the supposition before, and the same remarks which I made with regard to the former theory applies equally to this. We have first to prove the possibility of a high temperature at the bottom of the ocean before we can receive the explanation in question.

Another view concerning the formation of dolomite has created some attention, that of Forchammer. In the first place, he says:—"I designate as dolomite all limestone which contains more than 13 per cent. of carbonate of magnesia." Then, he supposes the action of springs; and he illustrates his supposition by certain geological deposits in Denmark. He supposes the action of springs rising through a coralline limestone. A solution of carbonate of lime is thus produced, and this carbonate of lime, in contact with sea-water, deposits, he thinks, dolomite, or deposits carbonate of lime containing carbonate of magnesia. But this only occurs when the water is boiling hot, so that we have here the same difficulty as I have pointed out on two occasions already. Mr. Sterry Hunt, a very able geologist, and one who has directed great attention, and with great success, to the application of chemistry to geological phenomena in Canada, supposes that water containing bicarbonate of soda, in acting upon sea-water, first decomposes the lime-salts, throwing down carbonate of lime, and only $\frac{2}{100}$ths or $\frac{3}{100}$ths of carbonate of magnesia. Then, when all the soluble lime-salts have been thus decomposed by the further addition of bicarbonate of soda, bicarbonate of magnesia is produced, which, by evaporation, becomes a hydrated carbonate. He admits, but does not prove experimentally, that when you get this hydrated carbonate of magnesia and carbonate of lime in contact under water, they combine slowly to form dolomite. It may be so, but that is one of the points that require special investigation. It seems to me every way reasonable that it should, but still we are not justified in concluding that such a combination does take place without the evidence of experiments.

Let me say one or two words about the grand hypothesis of magnesian vapour. The question which we have to deal with is not the geological structure of these mountains; and in order to illustrate the subject properly, I should require a diagram; but geologists know well the very celebrated locality to which I refer, to which it was attempted to apply this hypothesis of magnesian vapour—that carbonate of lime is deposited, that then, by some subterranean action, there was an eruption of magnesian vapour, which permeated this carbonate of lime, converting it into dolomite. Now, in the first place, magnesia is about one of the most fixed bodies in the world. It should be shown, first of all, that magnesian vapour can be produced. All our experiments lead to the contrary conclusion. But supposing magnesian vapour had been produced—supposing we could have evolved this magnesian vapour, and brought it in contact with the carbonate of lime, how could that have produced carbonate of magnesia? Where is the carbonic acid to come from to form the carbonate of magnesia under those conditions? What do we get? It appears to me the hypothesis, at all events, so far as we know anything of the properties of magnesia experimentally, is absolutely and wholly untenable.

CHEMICAL SOCIETY.

Thursday, January 21, 1863.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting were read and confirmed, and the following gentlemen balloted for and duly elected Fellows of the Society, viz.:—Mr. John Pentecost and Mr. Ramsay Morton.

Dr. Thudichum read the first part of a paper "*On Urochrome,*" the colouring matter of the urine. He said that colouring matter was the most obvious of all the ingredients of the urine, and essentially characteristic of the renal secretion. It was the alpha and omega of urinary analogies, as also of urinary pathology. Nevertheless, it had hitherto eluded the scrutiny of physiological chemists; and, although many had obtained certain products, none had actually isolated the colouring matter itself. Indeed, so difficult was the task of doing this, that Vogel, an author who had lately written on urology, had declared it to be impossible. The author believed, however, that if due regard had been paid to the labours of earlier chemists, the question would have been solved long ago. Sixty-three years ago, Proust had had more correct notions and better knowledge of the colouring matter of urine than the authors of the latest publications in Germany and this country. Dr. Thudichum continued by quoting what Proust had said upon the subject. He adverted to the fallow, odorous, and resinous substance which Proust had obtained from the urine by acids. Proust had already hinted that this might be but a product of decomposition of the original colouring matter, as, indeed, it was. This resin was described as fallow, or red, fusing in hot water like pitch, dissolving in alkalies, alcohol, and ether, and as almost insoluble in water. It was the essential principle from which the urine derived its colour and its flavour, and which caused the peculiar smell of linen moistened with urine, when it is heated. Dr. Thudichum next proved the identity of this fallow resin of Proust with a body which Schaeling had obtained from urine, previously concentrated by freezing, by extraction with ether. He showed that ether extracted yellow colouring matter and hippuric acid, and that the latter on heating decomposed the urochrome and yielded Schaeling's body. He next referred to a substance termed "custodine," by Heller, and described as an uncrystallisable brownish-red resin of acid reaction (pigmento-resinous acid), and to another matter termed "indirubine," from urine, by Schunck. He then discussed the nature of the colouring matters obtained from urine by Scherer, Harley, and Marcet, and claimed them to be more or less identical with the fallow resin of Proust, being either fallow resin in a pure state or mixed with peculiar impurities. Another product of the decomposition of urochrome was a peculiar black matter, obtained together with the resin. This had been well described by Proust, but almost entirely overlooked by subsequent writers. Some chemists had persistently thrown it away as dirt. Yet it was a definable chemical body of considerable interest and importance. This matter appeared as a black powder, insoluble in alcohol, and separated thereby from the resin. It was easily soluble in potash, and precipitated therefrom by acids as a bulky, dark-brown clot. On dry distillation, it left 65 per cent. of charcoal, being as much as common coal. Without doubt, persons who had read the account of Heller's "uroxanthine" and Schunck's "indican," would conceive the idea that this black matter might be the indigo derived from the matters just mentioned. But it was as different from indigo blue as the fallow resin was from indigo red. This last-named body was described by Berzelius as being insoluble in dilute acids and alkalies, and thereby differed from the resin, which was soluble in acids, and particularly so in alkalies. Moreover, the author had never found sugar as one of the products of the decomposition of urochrome, and he expressed his belief that the urine contained neither indican, which had the property of splitting up into indigo-blue, indigo-red, and sugar, nor that it contained uroxanthine, having the same properties. He held that the urine contained a peculiar colouring matter, characteristic of the renal secretion, and which he termed "urochrome." This yellow matter could be extracted and obtained in a pure state, as he would show on a subsequent occasion. By exposure to air this matter passed into a red variety, which still remained soluble in water and acids, and corresponded with the urerythrine of former authors, and the rosacic acid of Proust, Vanquelin, and Vogel. This was the matter colouring the pink sediments. Under the influence of acids and heat, when the oxygen of the air was excluded by performing the boiling in a retort in a current of hydrogen, the yellow urochrome became decomposed, yielding the fallow resin, or *uropittine*, and the black matter, or *uromelanine*, several volatile acids and substances, and, perhaps, a soluble matter remaining in the residues. One of the volatile matters the author described as a neutral essential oil, insoluble in water, soluble in spirit and ether, and having the peculiar odour of urine. With nitrate of oxide of mercury it gave the pink reaction on heating, which was observed in a small degree in the analysis made by Liebig's method. It was distinguished from the phenylic acid, also contained in urine, by not yielding a reduction of silver solution on boiling. This essential oil the author proposed to call "the otto of urine." Under the influence of putrefactive agents, the urochrome became similarly decomposed, yielding uropittine, uromelanine, and acetic acid, but little or no essential oil or otto. The author promised to describe more fully the chemical properties of the substances of which he had given a preliminary account, and the mode of their preparation, in a future communication. He added that, in a medical point of view, they appeared of great importance, as the resin sometimes appeared in the teeth of uræmic patients, and the skin of all patients affected with kidney disease excreted uropittine. It was only necessary to smell the exhalation from their skin in order, at once, to appreciate the truth of the assertion, that urochrome and its products of decomposition were most important elements in the theory of uræmia. This theory, as at present accepted, would, therefore, have to undergo modifications by a more extended knowledge of the colouring matter of urine and its bearing in the animal economy.

Mr. Robert Porrett, having made formerly a series of experiments upon the colouring matters of urine, was convinced that there existed more than one principle to which the tinctorial property was due. His experiments were directed to the separation of these bodies by means of sulphate of copper, which always gave a greyish-white precipitate, and this, boiled with potash, became decomposed, and, as the result, allowed the coloured resinous matter to enter into solution. The speaker concluded by expressing his personal obligations to Dr. Thudichum for the very elaborate report he had just now presented to the Society.

Dr. Harley, at the invitation of the President, rose to offer a few remarks upon the subject of Dr. Thudichum's communication. His name having been mentioned beside that of Scherer, with whom he had formerly the honour of being associated, he felt it a duty to record his dissent from some of the views expressed by the lecturer. The multiplication of names for the same substance was to be avoided; and he considered that, before a new term was generally adopted, it became necessary to sift the evidence of former inquirers to see whether or not such body had been previously isolated and described. He contended that the red colouring matter named by Scherer, urohæmatin, was the only principle of its kind existing in normal urine; the proportion in which it occurred was very small, but, by operating upon large supplies of material, a sufficient quantity had been prepared for the purpose of examination. A specimen of this body would be brought for the inspection of the Society, either at its next meeting or the one following; and he hoped by that time to be favoured with an opportunity of comparing it with Dr. Thudichum's urochrome, which he should like much to see. There was no doubt that the body Scherer had prepared contained iron, a circumstance which brought it into close analogy with the colouring matter of the blood. The name very well indicated this similarity, and he thought it feasible to suppose that its existence in the urine was directly attributable to the constant waste of the tissues in the animal organism, and that this was but the natural vehicle for the elimination of the disorganised blood corpuscles. Viewed in this light, the question was one of great importance to physiologists; and the colouring matter of urine afforded, perhaps, the most reliable indication of the state of bodily health, and this might be taken as a direct measure of the rate at which we were consuming the fuel in the lamp of life.

Dr. Thudichum replied to the effect that his experiments had been specially directed to the identification of the iron supposed by some to exist in the colouring matter of urine, but that the amount obtained by him was so excessively minute, that he did not consider himself justified in supposing it to be an essential component. For the detection of iron, the speaker had evaporated large quantities of urine to a small bulk, added nitric acid, and continued the evaporation in a platinum capsule, gradually deflagrating upon the same spot the saline residue thus obtained. On dissolving this matter afterwards in hydrochloric acid, and dividing it into two portions, it was barely possible to identify, by means of the sulphocyanide and ferrocyanide reactions, the existence of iron, its quantity being so small.

A note "*On the Absorption of Mixed Gases in Water*," by William M. Watts, Esq., B A., was read by the Secretary. The author had made experiments for the purpose of testing critically the truth of Dalton and Henry's hypothesis, which, in effect, asserts that gases in admixture behave as vacua to each other. The subject had already been worked upon by Bunsen, who examined the behaviour of carbonic oxide upon carbonic acid; by Roscoe, who described the results observed in the case of mixtures of hydrogen and chlorine, carbonic acid and chlorine; and the last named author, in conjunction with Sims, had examined ammonia and sulphurous acid. The mode of proceeding could not well be described without the assistance of the drawings, which would be engraved in the Society's Journal, but were on too small a scale to be shown to the meeting. Mr. Watts had, however, examined ammonia and hydrogen, both at zero and 20° C., also sulphurous acid and carbonic acid, in the presence of water, and in all cases had observed irregularities which still remained unaccounted for, whether a diminution of pressure, or diffusion into another gas, were resorted to in the inquiry. The general conclusion of the author's experiments led him to the belief that the proportion of the gases dissolved did not accord with the simple law of Dalton and Henry.

Mr. Adie, of Liverpool, favoured the Society with a further communication upon the subject of "*Ground Ice.*" During the late frosts Mr. Adie had observed opaque masses of ice submerged some ten or twelve feet beneath the surface of a running stream, and in one of these blocks he had counted as many as five stones enclosed. It was considered that the formation of ground ice was instrumental in transporting pebbles from the bed of a river towards its mouth.

The President trusted the ground ice hypothesis might not be open to the imputation, that it was the specific gravity of the pebbles which had caused the block of ice to remain submerged. He then declared the meeting adjourned until Thursday, February 4, when a paper by Dr. How, "*On the Minerals of Nova Scotia*," would be read.

ROYAL DUBLIN SOCIETY.

January 18, 1864.

Sir Robert Kane, M.D., F.R.S., &c., *in the Chair.*

The first paper for the evening was by Mr. Emerson J. Reynolds, on "*Spectrum Analysis*," of which we give the following abstract:—During the last two years the author has been, at intervals, engaged on the examination of Irish ores and minerals for the new metals, thallium, rubidium, and cæsium. Though far from successful in his search for the interesting strangers, although using the extremely delicate spectrum analytical method, yet in examining the large number of minerals necessarily passed in review, some facts were elicited, and observations made, which he would have the honour of laying before the Society. As this was the first paper connected with spectrum analysis which had been presented to the Society, the author expressed his intention of not confining himself to his own experiments, but of giving a general account of the mode of applying this new method of research to the examination of minerals. After briefly noticing the principles on which spectrum analysis is based, the delicacy of its indications, and the important discoveries made by its aid, the systematic treatment of the subject was then entered upon. The forms of apparatus used in making spectrum observations are very varied, but the principle remains the same in all. The essential parts of an instrument of this kind are—the slit, collimating lens, prism, and observing telescope (astronomical). Such is the "spectroscope" in its simplest form; but instruments are now constructed with as many as nine prisms, which have performed the same office for several of the lines of the solar spectrum that Herschel's or Lord Rosse's telescopes have done for some of the nebulæ. For all analytical purposes, the best instrument is that in which only one or two prisms are used, as a larger number obstruct too great an amount of light; and, moreover, the extent of spectrum to be observed is inconveniently large; this is particularly the case when hollow prisms are used, filled with bisulphide of carbon, as the dispersive power of that liquid is so much greater than glass. Spectroscopes, as hitherto constructed, generally have the second or observing telescope movable in an horizontal plane, and, in the case of a double bisulphide of carbon prism instrument, and when at about its mean position, it makes nearly a right angle with the tube carrying the slit and collimating lens. Hoffman, the celebrated optician, some time ago, introduced a very ingenious form of apparatus, which does away with the angular motion of the observing telescope, and enables the experimenter, by direct vision, to examine the spectrum of any flame to which he may point the instrument. Messrs. Yates and Son, of this city (Dublin), have recently introduced an improved form of direct vision spectroscope, which is one of the most perfect instruments of its kind which we have seen. The spectroscope used by the author he has had constructed on a principle different somewhat from that usually adopted. He employs two bisulphide of carbon prisms, with refracting angles of 60°. The peculiarity of the instrument consists in allowing the rays refracted by the first prism to fall on a plane mirror placed at the proper angle, by which they are reflected through the second prism placed with its apex close to the base of the first; by this means, and with a minimum number of prisms, the observing telescope is brought very close to the slit apparatus, so that the experimenter can adjust the latter and keep the source of light, &c., perfectly under command while at the eye-piece of the instrument. The methods by which the spectra of the metals of the alkalies and alkaline earths can be produced are too well known to need any detailed description, but there are some points to which attention may be drawn. The flame of Bunsen's gas-burner is the source of heat generally used, but the author strongly advocates the use of the simple hydrogen flame instead, on account of its more intense action on the bodies submitted to its influence, and the increased brilliancy of the spectra observed. A small apparatus constructed on the principle of a Döbereiner lamp can easily be kept ready for use at a moment's notice. The best jet at which to ignite the hydrogen is the shank of a common tobacco-pipe. The application of the secondary spark of the induction coil for the purpose of obtaining spectra was then noticed, and the advantages to be gained by its use pointed out. The author next alluded to the different modes at present in use for the measurement of the distances between the lines of the spectrum, and exhibited the mode which he adopts for the division of the spectrum. The application of the method of spectrum analysis to the examination of minerals was then treated of. In examining refractory minerals in order to obtain the characteristic spectra of the metals contained in them, the author employs a peculiar form of gas-jet, which is essentially a Herapath's blowpipe jet urged by a current of steam rendered acid by hydrochloric acid. The steam-jet should never be so powerful as to blow the test specimen off the platinum wires. By this means the decomposition of many minerals is effected without having recourse to the previous action of ordinary chemical agents upon them, as has been hitherto necessary in preparing them for examination in the spectrum apparatus. The discussion of the real aid to be derived from the application of the spectrum analytical method to general analysis was then entered upon, and Mr. Reynolds expressed his belief, on experimental grounds, that the various spectra materially interfered with each other, notwithstanding the statements of MM. Bunsen and Kirchoff and others to the contrary; and he showed that the presence of a considerable proportion of sodium and barium compounds, in a mixture of salts of different acids and bases, serves to completely mask or intercept the spectra of lithium, potassium, strontium, and calcium when present in comparatively small quantities. After discussing this portion of the subject at some length, the author expressed his belief that the method of spectrum analysis, as it now stands, beautiful and delicate though its indications are, must be looked upon rather as an useful aid to the ordinary analytical process than as a method of analysis, perfect in itself under all conditions. Mr. Reynolds concluded by observing that he has hitherto been unable to find any traces of rubidium or cæsium in any Irish minerals; but thallium was found in three specimens of copper pyrites from different portions of the Knockmahon mines, Bonmahon Co., Waterford, and in one specimen of the same mineral from Ballydehobb mine, Co. Cork. The amount of the metal present in every case was extremely minute. At the conclusion of the paper Mr. Reynolds gave a short description of thallium, and exhibited several fine specimens of the metal and some of its salts, kindly lent for the occasion by their discoverer, Mr. Crookes. These were handed round and much admired by those present.

The next paper was by Mr. O'Hara, C.E., "*On the Supply of Fuel in Ireland.*" At its conclusion the meeting adjourned.

ACADEMY OF SCIENCES:

January 25, 1864.

A memoir, "*On the Action of Oxygen on Animals,*" was presented by MM. Demarquay and Leconte, which deserves the attention of physiologists and therapeutists. We are glad to see that the possible curative effects of oxygen are once more attracting the attention of physicians and surgeons. A very curious fact observed by the authors was that nearly two litres of this gas might be injected into the veins of an animal without killing it. They found, too, a dog might inhale thirty or forty litres with no other effects than putting him in good spirits and creating a large appetite. They noticed, also, that the respiration of oxygen produced remarkable, and, up to a certain point, beneficial effects on large wounds which they made on animals.

A note, "*On Ammoniacal Fermentation,*" by M. Van Tieghem, was presented. By ammoniacal fermentation is meant the conversion of urea into carbonate of ammonia under the influence of water, a ferment, and a proper temperature. The author is a pupil of M. Pasteur; so we learn that the cause of the transformation of urea is the development of a special organised vegetable ferment. The author also found that, under the influence of apparently the same ferment, hippuric acid splits up into benzoic acid and glycollamine. Beer yeast, it is said, will not provoke the transformation of urea in the presence of sugar.

A note, by M. Reboul, announced the formation of "*Valerylene* $C_{10}H_8$." He obtained it by heating to 140° C. in sealed tubes a mixture of bromated amylene, and a saturated alcoholic solution of potash. Water added to the product of the reaction separated a light stratum, which was a mixture of valerylene, alcohol, and bromated amylene. Cold water removed the alcohol from this mixture, and the very volatile valerylene was separated from the residue by distillation. It is not absorbed by protochloride of copper. It combines with bromine to form a bi-, and, probably, a tetrabromide. Of these and other compounds and derivatives, we shall soon hear more from the author.

NOTICES OF BOOKS.

The Second Step in Chemistry; or, the Student's Guide to the Higher Branches of the Science. By R. Galloway, F.C.S., &c. London: Churchill and Sons. 1864.

This work is intended to teach the higher branches of chemical science, especially the newer views which are now being very generally adopted, and will be found a most efficient manual for the purpose. To criticise the matter of the book is impossible, since it would involve a criticism of all the views on the constitution of bodies which have been put forward by Griffin, Gerhardt, Williamson, Wurtz, Playfair, Frankland, Kolbe, and others. The arrangement of the matter deserves great praise. Mr. Galloway is a practised teacher of chemistry, and he states from experience that the difficult subjects of which the book treats can be taught with perfect success on the plan here developed. We have no doubt of this, and firmly believe that the student who goes conscientiously through the book, performing all the exercises which are given, will find himself, when he gets to the end, an accomplished theoretical chemist.

Practical points, however, are not altogether neglected; and much useful information will be found, particularly on fractional distillations, and the method of determining the boiling points of liquids, &c.

Mr. Galloway has supplied a want which we know has long been felt by the constant inquiries we have had for a work treating of recent theories, and we have great pleasure in recommending the book to our readers.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

3232. James Shanks, St. Helen's, Lancashire, "Improvements in the manufacture of caustic soda and caustic potash."

3264. Joan Maynes, Manchester, "Improvements in the manufacture of certain descriptions of artificial manure, and in apparatus to be employed therein."

3284. Henri Reda de Saint Martin, Old Compton Street, Soho, London, "Improvements in apparatus for aërial locomotion."

3290. Henry Caunter, Stornoway, Lewis, Ross, "Improvements in the manufacture of lubricating matter or composition."

3296. Thomas Barnes Cochrane, Earl of Dundonald, Queen's Gate, Kensington, London, "Improvements in the production of hydro-carbon and other oils from gas tar, coal tar, gas pitch, asphalte, coal and other bituminous substances."

3302. George Phillips, Holborn Hill, London, "Improvements in the production of aniline colours."—Petitions recorded December 30, 1863.

Notices to Proceed.

2293. George Davies, Serle Street, Lincoln's-Inn, London, "Improvements in the manufacture of iron and steel, and apparatus to be employed in such manufacture."—A communication from William Gerhardt, Philadelphia, Pennsylvania, U.S.—Petition recorded September 18, 1863.

2912. George Rait, Canal Bridge, Kingsland Road, London, and John Winsborrow, Castle Terrace, Pownall Road, Dalston, Middlesex, "Improvements in the construction of dry gas meters, and in the means or apparatus employed therein."—Petition recorded November 20, 1863.

2917. Richard Laming, Priory Road, Kilburn, West Hampstead, Middlesex, "Improvements in preparing materials useful in the purifying of gas from sulphuretted hydrogen, carbonic acid, and ammonia, and in making ammoniacal compounds."—Petition recorded November 26, 1863.

2187. William Lorberg, Wyld's Rents, Bermondsey, Surrey, "Improvements in the manufacture of gas and other substances from tan and similar materials."

2189. Samuel Millbourn, Wallington Paper Mill, Carshalton, Surrey, "Improvements in the preparation of materials for the manufacture of paper, and in the construction of machinery employed for such purposes."

2208. Thomas Henry Baker and George Friend, Tunbridge, Kent, "Improvements in treating excrementitious and sewage matters, and in the means or apparatus employed therein."

3116. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of india-rubber and gutta-percha compounds."—A communication from Thomas Mayall, Roxburgh, Massachusetts, U.S.—Petition recorded December 10, 1863.

CORRESPONDENCE.

The British Pharmacopœia.

To the Editor of the Chemical News.

Sir,—Can you inform me when I am to begin to dispense the medicines of the new Pharmacopœia; and what I am to do in the case of prescriptions written before the publication of the new formulæ?

I am, &c. M. P. S.

London, February 4.

[Our correspondent may begin as soon as he pleases; and the sooner he gets the new preparations the better for himself, or he will be distanced by competitors in business. With regard to old prescriptions, they ought properly to be dispensed according to the Pharmacopœia in use at the time they were written; but we do not think the differences in the preparations altered are of sufficient importance to make it necessary for a druggist to keep a double stock.—Ed. *C. N.*]

MISCELLANEOUS.

Inspector of Alkali Works.—The Committee of Privy Council for Trade have appointed Robert Angus Smith, M.D., F.R.S., F.C.S., to be the Inspector of Alkali Works, in conformity with the provisions of the 26 and 27 Vict., c. 124. All parties concerned may be congratulated on this appointment, which is, perhaps, the best that could have been made.

Pharmaceutical Society.—Two lectures will be delivered in Bloomsbury Square on the "British Pharmacopœia." 1. On Wednesday evening, February 17, at half-past eight o'clock, by Professor Redwood, Ph.D. 2. On Wednesday evening, February 24, at half-past eight o'clock, by Professor Bentley, M.R.C.S. Other lectures will be delivered in the ensuing month.

Royal Institution.—Tuesday, February 9, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Thursday, February 11, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Friday, February 12, at eight o'clock, Professor Wanklyn, "On the Synthesis of Organic Bodies." Saturday, February 13, at three o'clock, Professor Frankland, "On the Metallic Elements."

New Reaction for Veratria.—Trapp, of St. Petersburg, has observed that the smallest traces of veratria dissolved in cold concentrated chlorhydric acid, gives a colourless solution, which, on continued boiling, assumes a red colour, that finally becomes very intense, and resembles that of permanganate of potash. This solution remains unaltered by standing for a long time.—*Polytechnisches Notizblatt*, 1863, 96.

Relations of Measures to Weights in the British Pharmacopœia:—

1 gallon	=the measure of	10	pounds	of water.
1 pint	= ,,	1·25	,,	,,
1 fluid ounce	= ,,	1	ounce	,,
1 fluid drachm	= ,,	54·68	grains	,,
1 minim	= ,,	0·91	,,	,,

Relation of the Weights to Metrical Weights.

1 pound = 453·5925 grammes
1 ounce = 28·3495 ,,
1 grain = 0·0648 ,,

Relation of the Measures to Metrical Measures.

1 gallon = 4·543487 litres
1 pint = 0·567936 ,,
1 fluid ounce = 0·028396 ,,
1 fluid drachm = 0·003549 ,,
1 minim = 0·000059 ,,

—*Appendix to British Pharmacopœia.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

J. Whitfield.—We do not know what compound is meant. Chloride of calcium may be obtained in crystals. Hypochlorite of lime we have never seen in a separate state.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Blowpipe Reaction of Copper, *by Dr.* B. W. Gerland.

The practitioners of the blowpipe will share with me in astonishment when shown that the behaviour of the copper bead in the deoxidising flame—under circumstances whose control can be acquired by practice—is different to that described in chemical literature, and relied upon by all chemists as one of the most characteristic reactions.

After long exercise, I have so far succeeded in the management of the blowpipe flame produced by a gas jet, as to have it sufficiently under my control to use it for all purposes of qualitative and quantitative blowpipe analysis; but I have been unable to obtain the red opaque copper bead on the eye of a platinum wire in the deoxidising flame. The bead thus produced shows the characteristics of glass coloured by protoxide of copper. When removed out of the inner flame, the bead is perfectly colourless and transparent, and remains so after cooling; but when again gently heated by holding it close to the flame, a beautiful ruby red diffuses itself through the glass without disturbing its transparency. This colour is not affected by cooling, but disappears by exposure to a stronger heat, and does not return with cooling. It can, however, be reproduced by a low heat, as in the first instance. The changes are best observed when the bend of the platinum wire is made rather wide, and not too much borax used, so that the bead becomes elongated. If a little copper is dissolved in the flux, the glass is rendered colourless in the deoxidising flame, and one end of the bead is brought near the flame. This half turns ruby-red, whilst the other half is left too cold to take the colour; but the first half, when left for a moment in the exterior flame, becomes colourless by over-heating, and at the same time the other end is heated sufficiently to redden in its turn. When a large quantity of borax is used for the experiment, it sometimes happens that, after treatment in the deoxidising flame, the ruby colour appears during the cooling of the bead.

The reaction is extremely sensitive. If the borax contains so little copper that the oxidised bead scarcely shows a bluish tint, or shows it only when held in the yellow flame, it can in the described manner be coloured a decided ruby. I have even obtained the ruby colour when the only source of the copper was that which the flame volatilised from the copper burner, moistened with hydrochloric acid. The importance of the reaction is still more evident from the fact, that it is not concealed by the presence of other metals which colour the glass under the same circumstances, unless their quantity is so great as to make the bead opaque. If, for instance, the flux contains chromium, the presence of a small quantity of copper manifests itself in the change of the green when treated in the described manner. Such metals as lead, bismuth, &c., which, in the deoxidising flame, darken the glass by the separation of a metallic substance or of a lower oxide, do not interfere with this reaction; for if their quantity is not large enough to make the bead quite black, the ruby colour can easily be observed, particularly by the change produced in warming, whereas in the other case it will be found easy to separate the larger proportion of the metal in flakes, thus leaving the glass lighter coloured. Molybdanium, when present in large proportion, requires attention from the following peculiarity of behaviour. If present in sufficient quantity, this metal colours the deoxidised borax smoky brown, leaving it transparent, but the colour changes into dark brown, and the glass becomes opaque when reheated. It is therefore advisable to volatilise the molybdanium by a longer exposure to the blowpipe flame. I have in this way been able to discover in its compounds minute traces of copper when all other means failed in detecting its presence.

The appearance of the ruby colour in the colourless deoxidised bead seems to be conditioned by the first degree of softening of the glass, and disappears when it is molten. The reaction can be produced both with borax and phosphate of ammonia, but the latter has the disadvantage of making the test less sensitive; and the colouring and discolouring might easily escape notice, in consequence of the low melting-point of the flux. The ruby colour of the salt of phosphorus bead has been already observed by Berzelius, who describes it in the following words:—"Salt of phosphorus dissolves it (copper) with the same colour as borax. The glass, containing a small amount of copper, after treatment in the reduction-flame, becomes sometimes ruby red, and this takes place generally at the moment of congealment." (Berzelius, *Anwendung des Lothrohrs*, 4te Auflage, page 96.) Other authors make no mention of this.

The introduction of metallic tin into the bead, which is recommended to facilitate the deoxidation of the oxide of copper in the flux for the production of red opaque glass, has no effect upon the reaction.

The depth of the ruby colour depends upon the quantity of copper in solution.

In conclusion I have to mention, that in all my experiments by which the ruby glass was obtained, metallic copper had separated from the flux, and was found alloyed with the platinum of the wire. In fact, by prolonged treatment in the deoxidising flame, the copper can be perfectly separated from the glass. The wire can be boiled with water and with sulphuric acid without parting with its copper, but when borax is again fluxed on the same in the exterior flame, this metal slowly dissolves itself. This way of cleaning the platinum is, however, very tedious, and it is preferable to add some saltpetre to the flux.

Macclesfield, January, 1864.

TECHNICAL CHEMISTRY.

Purification of Arseniferous Sulphuric Acid, *by MM.* Bussy *and* Buigne.

Among the substances which most affect the purity of sulphuric acid, and which it is necessary to separate, arsenic, which is now found in considerable quantities in most acids prepared with pyrite sulphur, is the most important. It is only necessary to call to mind the properties of this energetic toxic agent, and the effect it may have when sulphuric acid is used in medico-legal research, or even in simple pharmaceutical or chemical preparations, to perceive with what care sulphuric acid should be purified before it is used in the laboratory.

In the simple distilling process described in the Codex of 1837, arsenic has not been taken into account; the object of this process was to separate the acid, which is volatile and boils at 326°, from the sulphates of lead and potash which the acid generally contains, and which, at this temperature, become fixed. As to arsenic, which, both in its elementary form and as arsenious acid, possesses a considerable vapour tension, under this condition it is admitted that it will volatilise, in more or less quantity, with the sulphuric acid, and thus that the distilling process is consequently inefficient to separate the arsenic.

It is desirable, no doubt, that only sulphuric acids free from arsenic should be in the market; but as a considerable portion of that produced is arsenical, it must be purified; hence the various processes proposed from time to time.

One of the first is that in which sulphuretted hydrogen is used. This gas is passed into a flask a quarter full of impure sulphuric acid; it is shaken every now and then, left to settle, and filtered through asbestos.

In operating on concentrated sulphuric acid, its partial decomposition is effected by the following reaction, and sulphur and water are produced,—

$$3HS + SO_3HO = 4HO + 4S.$$

It is, then, indispensable to dilute sulphuric acid before submitting it to the action of sulphuretted hydrogen. This gas merely precipitates the arsenic, whilst the acid undergoes, at least to all appearance, no decomposition. The acid must afterwards be concentrated to restore its primitive density; and at a certain point, on account of the high temperature of the liquid, a small quantity of the products of the preceding reaction reappear. Previous dilution of the sulphuric acid only diminishes, without removing, the inconvenience. However prolonged the sulphuretted hydrogen current, sulphuric acid submitted to its action always retains an amount of arsenic perfectly appreciable by Marsh's apparatus.

In a work published in 1845, and an extract from which appeared in the *Comptes Rendus*, vol. xx., p. 794, M. Dupasquier draws the attention of chemists to the advantage of using sulphide of barium as a means of purifying arseniferous sulphuric acids. This chemist finds, in fact, that, both with regard to economy and the purity of the product, sulphide of barium is preferable to hydrosulphuric acid, the inefficiency of which he has elsewhere shown.

M. Dupasquier's process consists in adding 30 per cent. of water to the acid which is to undergo purification, heating to 100°, and then throwing in a few milliemes of crystallised sulphide of barium. Sulphide of arsenic soon collects in the form of a yellowish deposit at the bottom of the vessel; the clear liquid is decanted, and its original density, =1·85, restored by evaporation.

In presence of sulphuric acid, sulphide of barium becomes sulphuretted hydrogen and sulphate of baryta—

$$BaS + SO_3HO = BaOSO_3 + HS.$$

This instance, then, becomes similar to that preceding, and the sulphuretted hydrogen separates the arsenic as sulphide, by the same reaction as in the other process, only it does it more completely, due to the nascent state of the gas whilst in contact with sulphuric acid.

The same inconveniences, however, attend M. Dupasquier's process, the principal being—1. The necessity of previously diluting the sulphuric acid. 2. The impossibility of immediately expelling the dissolved sulphuretted hydrogen. 3. The necessary reaction occurring during the concentration of the sulphuric acid. And to these is added the special difficulty of the pharmaceutist to obtain pure sulphide of barium. If the sulphide employed is so far impure as to contain one equivalent of hyposulphite of baryta mixed with two equivalents of sulphide of barium, the action of sulphuric acid on such a mixture produces only sulphur and water. The first effect of this action would be to disengage two equivalents of sulphuretted hydrogen and one of sulphurous acid, but these two gases, reacting reciprocally, would decompose according to the equation—

$$2HS + SO_2 = 2HO + 3S.$$

A condition indispensable in M. Dupasquier's process is, then, the use of barium free from hyposulphite, and this condition is not very easy when the salt is prepared at the moment it is required.

This fact, added to those described above, makes M. Dupasquier's process ill-adapted to the laboratory, though it may be very good on a large scale during the course of preparation of sulphuric acid in manufactories. Is there not, for instance, a very serious practical inconvenience in diluting impure acid with 30 per cent. of water, which must afterwards be expelled by evaporation, especially if it be considered that the concentration of sulphuric acid is far from being as simple as that of an ordinary saline solution?

This dilution of the sulphuric acid is not necessary in Buchner's process, which is based on the use of hydrochloric acid. Starting with the principle, that chloride of arsenic boils at 132°, while sulphuric acid boils at 326°, Buchner places the impure acid in a balloon, and gradually raises the temperature, then he passes into it a current of hydrochloric acid, which converts the arsenic into chloride. The hydrochloric acid is then got rid of by a few minutes' boiling in the open air.

This process is both easy and simple; but, unfortunately, it does not entirely free the sulphuric acid from arsenic. We have repeated it several times, under conditions best calculated to ensure success, that is to say, by bringing the sulphuric acid very near its boiling point, and prolonging for more than an hour the current of hydrochloric acid, and yet we have never succeeded in obtaining absolutely pure sulphuric acid. The greater part of the arsenic, it is true, had disappeared, but an appreciable quantity always remained in the product. Hence the means we possess for freeing sulphuric acid from arsenic are satisfactory to neither chemists nor pharmaceutists. Before seeking new processes, we desired to thoroughly examine the effects of distillation on commercial sulphuric acid, and to see whether, as is generally supposed, the arsenic is taken in vapour into the distilled product. M. Dupasquier has already (*Journal de Pharmacie*, vol. ix., p. 419) given the results of experiments which are in opposition to this theory; but being preoccupied with a purifying process applicable to commercial purposes, he has not thought it necessary to insist on these results, and they do not figure in the *resumé* of his conclusions.

I wish, therefore, to draw attention to this point, and to study the distillation of arseniferous sulphuric acid under the most varied and the most positive conditions.

We have a Marsh's apparatus, so precise and sensitive as to enable us to ascertain, in a given weight of sulphuric acid, not only the mere presence, but, up to a certain point, the proportion of arsenic contained in it. With twenty grammes of arseniferous sulphuric acid we have obtained with this apparatus, beyond the heated part, an appreciable quantity of arsenic, in the form of a ring; and we are, moreover, certain that this ring represented the whole of the arsenic yielded in the form of arseniated hydrogen; for in no instance have we succeeded in obtaining the arsenical spot by igniting the gas at the end of the tube. We were thus on the road towards solving the question.

Choosing an evidently arsenical sulphuric acid, obtained from pyrites, we distilled it with the usual precautions,* and divided the distilled product into portions. The weight of acid on which we experimented was 840 grammes; its degree of density, 1·82.

The first product distilled weighed 170 grammes; density, 1·54. The second product distilled weighed 280 grammes; density, 1·83. The third weighed 180 grammes; density, 1·84. The residue of this distillation weighed 210 grammes, with a density of 1·84.

Now, by submitting twenty grammes of each of these acids to the test of Marsh's apparatus, we observed two evident and significant facts:—

1st. No arsenic was observed either in the form of ring or spot in any of the three products.

2nd. The residue of the distillation, brought to the original weight by the addition of absolutely pure sulphuric acid, behaved in the same way as the acid first used, and furnished, with the same weight, an exactly similar ring.

Thus no trace of arsenic appeared in the volatile products of the distillation, while the whole of it appeared, and in a concentrated state, in the fixed residue of this same distillation.

Such a result would be difficult of explanation if, as many chemists suppose, the arsenic were present in the sulphuric acid, as arsenious acid. Under an ordinary degree of pressure we know that arsenious acid volatilises below red heat, at a temperature not much above 400°. Its vapour has, then, a sensible tension of its own at 326°, and this tension becomes still greater when arsenious acid exists in a current of vapour like that produced by boiling sulphuric acid. Supposing that the greater part of this acid remains in the residue of the distillation, we ought at least to find considerable quantities in the distilled product, which is not conformable to experience.

On the other hand, if we admit that it is present in the form of arsenic acid, nothing is easier than to explain the precision of the results of the distillation. Arsenic acid is by no means volatile; it decomposes above red heat into arsenious acid and oxygen; but up to that point it gives no appreciable vapour. Under the conditions of the present experiment it may, therefore, be regarded as absolutely fixed, so that, unless by projection or mechanical means, it is easy to understand that the distilled sulphuric acid ought to contain no trace of arsenic.

The following are the direct experiments which confirmed these purely theoretical previsions: — 1000 grammes of absolutely pure sulphuric acid, yielding neither ring nor spot in Marsh's apparatus, we divided into two equal portions; to one portion we added 0·50 gr. of arsenious acid; to the other, 0·50 gr. of arsenic acid. Each portion having been introduced into a similar retort, and placed under the same conditions, we distilled them both, in each case avoiding the least projection, and rendering all the circumstances of the distillation as alike as possible. We thus distilled three-quarters of each portion, leaving as residue, in the retort, a quarter of the acid originally introduced. Having then submitted the two distilled products to the test of Marsh's apparatus, we found, unmistakably, that the portion to which arsenic acid had been added was absolutely free from this toxic agent, while that to which we had added arsenious acid contained very appreciable traces of it. Though many times repeated, the results of this experiment were always the same, so that it is impossible to attribute the presence of arsenic to accidental projection, which might have happened in the case of arsenious acid.

Since it is evident, that as the commercial sulphuric acid on which we operated furnished, by distillation, a product absolutely free from arsenic, the acid must have contained arsenic acid. We have obtained direct proof of this by submitting the residue of the distillation to the two following tests:—

1. We concentrated part of the residue almost to dryness, added a little filtered water, then treated it by nitrate of silver. On pouring ammonia, drop by drop, into the liquid, we saw, immediately the saturation was completed, a red, brick-like precipitate form, characteristic of arseniate of silver.

2. We submitted the other portion to the action of a current of sulphuretted hydrogen, which separated the arsenic in the state of sulphide, its composition corresponding to the degree of oxygenation of the arsenical compound. This precipitate, collected, washed, and dried, was dissolved in ammonia, and then treated by excess of nitrate of silver. All the sulphur of the sulphide of arsenic was precipitated in the state of black sulphide of silver; and the filtered liquid, carefully treated with nitric acid, gave, as in the preceding experiment, exactly at the end of the saturation, the characteristic red, brick-like precipitate of arseniate of silver.

From these experiments, it appears that arsenic acid is not like boric acid, which, though itself fixed, is easily carried off in boiling water vapour. But it must be considered that, although the vapour acts, in some instances, mechanically, it may likewise act chemically, by reason of a special affinity. Thus, boric acid is more easily carried off by alcohol vapour, even at the temperature of 78°, because, as Ebelmen has shown, there exists great affinity between boric acid and alcohol, and the combination resulting from this affinity possesses the property of volatilising in a current of alcohol vapour. No such affinity seems to exist between sulphuric and arsenic acids. Experiments have proved that the latter preserves all its fixity, even when placed in a current of boiling sulphuric acid.

The above results, moreover, accord perfectly with the conclusions in M. Dupasquier's memoir (*Comptes Rendus*, vol. xx., p. 794), namely, that arsenic in commercial sulphuric acids is in the state of arsenic acid. Nevertheless, the many experiments we have made on other sulphuric acids drawn from different sources do not allow us to adopt this conclusion unreservedly.

The state in which the arsenic is present must evidently depend on the mode of preparing the sulphuric acid. The two elements essential to the formation of sulphuric acid, nitric and sulphurous acids, exert, with respect to the compounds of arsenic, a very different action, the first changing the arsenious into arsenic acid, the second, on the contrary, converting the arsenic into arsenious acid. Thus, according to the agent remaining in excess at the close of the operation, we have an oxidising or a reducing effect—a fact we have proved by experiment.

Among the numerous acids on which we have operated, some there are—not very many, it is true—in which arsenic existed evidently in the state of arsenious acid, AsO_3. Concentrated and submitted to the two tests above described, these acids failed to give the red, brick-like arseniate of silver precipitate, but gave instead a

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* The principal rules are: 1st, to use the grille annulaire, now generally employed, which allows the liquid to be heated from the top; 2nd, to put into the retort fragments of quartzite or pyromac silex in flakes, which are of great use in preventing bumping, and, consequently, avoiding accidental projections of liquid.—(Lembert, *Journ. de Pharm.*, vol. xii., p. 166.)

light yellow precipitate characteristic of arsenite of silver. Distilling them with the preceding precautions, we found that the product was not absolutely free from arsenic, but contained slight traces of it, which agrees perfectly with the foregoing theoretical and practical indications.

We at first imagined that the presence of arsenious acid in such acids was incompatible with the coexistence of nitrous products, and experiment verified our surmise. Our own experiments have shown us that the sensibility of narcotine and sulphate of protoxide of iron, as a means of appreciating the presence of nitrous compounds, exceeds the limit of $\frac{1}{100000}$. †

Now, by neither of these re-agents have we obtained an appreciable reaction in sulphuric acids which contained arsenic in the state of arsenious acid.

This relation between the state of the arsenic and the presence or absence of nitrous compounds, is very valuable, affording a means of rendering the distillation efficacious in either case.

Suppose it were desired to purify a decidedly arsenical sulphuric acid; begin by testing it either by narcotine or sulphate of protoxide of iron. If it contains nitrous products, we may be certain that arsenic is present as arsenic acid, AsO_5. It is then necessary only to add a few milliėmes of sulphate of ammonia,‡ and then to distil, carefully avoiding any kind of projection. The product is shown by Marsh's apparatus to be wholly free from arsenic.

Does the testing by re-agents show, on the contrary, the absence of nitrous compounds? There is every reason to believe that arsenic is present in the form of arsenious acid, AsO_3; and experiment proves that simple distillation without any previous treatment is insufficient.§ In such a case the sulphuric acid must be boiled with a little nitric acid, which fixes the arsenical compound by transforming it into arsenical acid, AsO_5. Then add sufficient sulphate of ammonia to destroy the excess of nitrous compounds, and finally distil under the same conditions as the preceding. The product is free from arsenic, and quite as pure as that of the preceding operation.—*Journal de Pharmacie et de Chimie*, vol. xliv., 177. 63.

Bleaching Sponges, by M. ARTUS.

ON a first trial M. Artus washed some good sponges several times in river water, and placed them, still wet, in a bath composed of six parts of water and one of commercial hydrochloric acid, there left them until carbonic acid ceased to be disengaged, when, after very careful washing, they were strung together and suspended in a vessel containing diluted hydrochloric acid and 6 per cent. of hyposulphite of soda dissolved in water. This vessel was well closed, and left for forty-eight hours, and the sponges afterwards taken out and washed in fresh water. M. Artus afterwards made a similar experiment, but doubled the quantity of hyposulphite of soda. Subsequently, in a third operation, the sponges, on being removed from the bath, were treated by diluted hydrochloric acid, from which they were freed by repeated washings in water, and were immediately exposed to the action of sulphurous acid. By each of these three methods nearly the same result is obtained, but the sponges were not perfectly blanched. A fourth method was then attempted. The sponges were well washed for some time in hot, diluted soda lye; then, as in the last experiment, they were immersed in a bath of weak hydrochloric acid and hyposulphite of soda, but only half the quantity of this salt employed in the first experiment was used. A satisfactory result was thus obtained.—*Moniteur Scientifique.*

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

I.—THE NOVELTIES IN THE PHARMACOPŒIA.

(*Continued from page* 66.)

We conclude in this number our account of the novelties in the Pharmacopœia.

Podophylli Resina.—This is podophyllin, the resin obtained from the root of *Podophyllum peltatum.* Podophyllin was introduced from America, and our supply of the medicine has hitherto been obtained from the States. Directions for the preparation of it are, however, given in the Pharmacopœia as follows:—The root is to be exhausted by rectified spirit, and the greater part of the spirit is to be distilled from the tincture. The residue is then to be slowly poured into water acidulated with hydrochloric acid. The resin is thrown down by the water, and is collected on a filter washed and dried. The object of the hydrochloric acid is not very clear. Podophyllin is a powerful cathartic. The test given is, "almost entirely soluble in ether," which might be said of half a dozen substances with which podophyllin could be adulterated.

Potassæ Permanganas.—Crystallised permanganate of potash is ordered for the preparation of a liquor potassæ permanganatis, in the proportion of four grains to an ounce of distilled water, The crystals of the salt should always be used, and not the fused lumps often sold, which contain a variable proportion of caustic alkali. A process is given for the preparation of the permanganate, about which it need only be said that care must be taken to carry the heat far enough, and continue it long enough, or the first crop of crystals will be sulphate of potash.

Potassii Bromidum, bromide of potassium, is placed in the British Pharmacopœia. The process for making it given is, by dissolving bromine in solution of potash to a very slight excess, evaporating the solution to dryness, and fusing the pulverised residue with charcoal. The fused mass is dissolved in water, the solution filtered, and the bromide obtained in crystals in the usual way. This process is most generally followed by makers of the salt.

Saccharum Lactis, sugar of milk, has been borrowed from the homœopaths, and placed in the Materia Medica; but we have not yet discovered any compound in which it is prescribed, nor can we think of any in which it should be. Under some circumstances it is a very useful food for infants. We would quote the description of the characters of sugar of milk, but it is too long. It is impossible, however, to resist the description of

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† We have prepared sulphuric acid perfectly free from nitrous products by boiling it with a little sulphate of ammonia, and we have proved that sulphate of protoxide of iron, reduced to powder and thrown into this liquid, there preserves its whiteness unsullied. But on taking 50 grammes of this acid, and carefully mixing it with a single drop of nitrous nitric acid—that is to say, about 1-1000th in weight—the re-agent immediately acquired a remarkably intense violet colour. By adding successively to this mixture increasing quantities of pure sulphuric acid, so as progressively to reduce the proportion of nitrous nitric acid, we obtained a dead rose colour when the proportion of this compound was reduced to 1-100000th. Narcotine is almost as sensitive; but, as it becomes yellow under the influence of pure sulphuric acid, it is more difficult to determine where the foreign coloration ceases. We believe, however, that it is less sensitive than sulphate of protoxide of iron.

‡ The addition of sulphate of ammonia decomposes the nitrous products, as proved by M. Pelouze.

§ The quantity of arsenic distilled in the case of arsenious acid is really very small, yet sufficient to render the acid containing it unfit for medico-legal researches.

Saccharum Album, refined sugar. "Compact, crystalline, conical loaves, snow-white, dry, scentless, and intensely and purely sweet." This description does the author great credit, whoever he may be; it is almost as good as Dr. Johnson's description of net-work.

Santonica.—This drug is known as *Semen contra*, or worm seed, though it is not a seed, but "the unexpanded flower-heads" of a species of artemisia. The flower-heads themselves are used as an anthelmintic; but a crystalline neutral principle is to be obtained from them, which is supposed to possess all the power of the drug. *Santoninum*, the principle in question, is procured from santonica by a very simple process, although the directions here given are very long.

Scammoniæ Radix.—Scammony root is now placed in the Materia Medica for the preparation of scammony resin, an article which the medical profession and pharmaceutists have long had the opportunity of using, but have declined to do so. As the use of it is still optional, except in the misturæ scammonii (a most absurd preparation to put in this Pharmacopœia), there will yet be very little demand for it. It is obvious that the object of using the resin in the mixture is to have a medicine without smell which will deceive a child; scammony, therefore, cannot be substituted, or rather will not fulfil the object. Scammony resin is obtained from the root by exhausting it with alcohol, adding a little water to the tincture, and then distilling off the spirit. The residue is removed while hot, and when it has cooled, any supernatant liquor is poured away, and the resin is then dried. The misturæ scammonii mentioned above, is made by triturating four grains of the resin with two fluid ounces of milk.

Soda Caustica, caustic soda, needs no notice.

Sodæ Arsenias, arseniate of soda, is here described as crystallising with fourteen atoms of water, although, in general, it obstinately crystallises with twenty-four atoms. This, however, is not of any consequence, since the salt is always to be used dried at or below 300°. The liquor sodæ arseniatis is made with four grains of the dried salt to a fluid ounce of distilled water.

Spiritus Pyroxylicus Rectificatus, rectified wood spirit. What this is placed in the Pharmacopœia for we cannot imagine.

Terebinthina Canadensis.—Canada balsam is put in to replace Chio turpentine, which is here omitted. It will be ordered in pills, we presume, which the dispenser will have to make with a considerable bulk of magnesia.

Zinci Carbonatis, pure carbonate of zinc, we presume is added to replace calamine, which is dismissed from the Pharmacopœia.

Zinci Valerianas, valerianate of zinc, is made, by the process of the Dublin College, from valerianate of soda. Very few of our readers will think of making this salt, so we need not quote the instructions.

We have now gone through the Materia Medica, and made our readers acquainted with all the more important additions and alterations. In future notices, we shall go through the list of preparations and compounds, commencing, however, with the galenical preparations.

At this stage it may be expected that we should express some general opinion on the merits of the British Pharmacopœia. In forming this opinion, it is impossible to forget that the book has now been more than four years in preparation, and that it has cost a sum of money variously stated at 6000*l.* or 8000*l.* We have, of course, no interest in depreciating the value of literary and laboratory work, but we have no hesitation in asserting that, for aught we have been able to discover to the contrary, the work could have been as well prepared in less than twelve months by any moderately-accomplished chemist and pharmaceutist, who would have thought himself richly rewarded with 400*l.* or 500*l.*

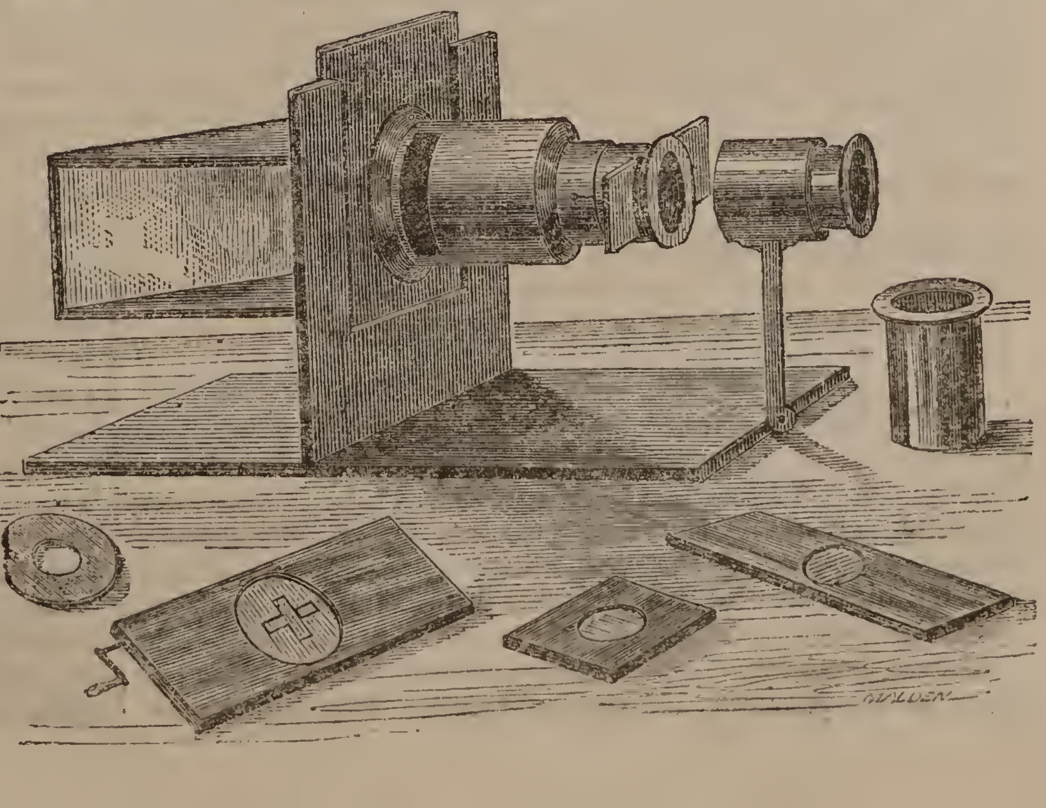
No doubt the contentions between the three colleges about their rival preparations were frequent and severe; no doubt, the debates on such questions, as whether iodine should be called iodum or iodinium, and whether pil. galbani co. should, for the future, be known as pil. assafœtidæ co. or not, were as long and fierce as the disputes in the old schools on such questions as—How many angels can balance themselves on the point of a needle? We, however, have only to judge of the results. Although the book has been all these years in preparation, it bears evident marks of having been put together in a hurry. Some of the directions are incomplete and faulty. The bulk of the work is mere compilation. Much of it is taken up with prescriptions such as medical men should be left to write at their discretion: *e. g.*, mist. creosoti, mist. scammonii, pil. plumbi c. opio. The chemistry does not fairly represent the science of the day. Taken altogether, the book would be no great credit to a single college or writer. As the production of the collective wisdom of the Medical Council, it is far from likely to increase the respect which that learned body has inspired.

PHYSICAL SCIENCE.

New Lantern Polariscope.

Mr. Samuel Highley, the microscope and philosophical instrument maker of Green-street, Leicester-square, has just introduced an arrangement that has long been a desideratum with those who delight in popularising science—namely, a polariscope that could be used in conjunction with the numberless magic lanterns that are now scattered over the kingdom and our colonies, without entailing the risk and trouble of sending them to the optician "to be fitted" with such an adjunct, and at a cost that is within the means of most persons who indulge in such pursuits.

Mr. Highley's instrument is figured in the annexed woodcut. The various parts are mounted on what the inventor calls a "gout-board support." The upright is



fitted with an adjustable panel, that carries a bundle of glass plates on one side, and the stage and power on the other. This allows of the entire arrangement being accurately "centred" with any lantern with which it may be employed. When adjusted, the panel is clamped by means of a milled-head screw. The "bundle" consists of such a number of thin glass plates as will give a bright reflected beam of polarised light, and is attached to the panel at the proper angle for producing such a beam. The spring stage for carrying selenite designs, unannealed glasses, pressure and heating clamps, and the larger objects, is formed within a large tube attached to the front side of the panel; and to the front of this is screwed a spring jacket, within which slides the power and stage for the smaller crystals employed. To the front part of the base-board an adjustable rod is fixed that carries the analyser, which consists of a large prism, made expressly for the purpose of giving a large and pure field of colour, the absolute field attainable being, of course, dependent on the intensity of the source of light employed, as oil, oxy-calcium, oxy-hydrogen, or the electric. Provision is made for rotating both the smaller and larger objects, when necessary for the demonstration of certain phenomena. When selenite designs are shown on the screen, the crystal power is replaced with another of suitable construction. To use this polariscope, the nozzle is placed at right angles to the screen, and the base-board is then clamped to the table. The front lenses of the magic lantern are removed, the condensers only being employed, and the source of light moved till a beam of parallel rays is produced. The lantern nozzle is then pointed at the bundle till the rays are incident at the polarising angle for glass, the proper direction being indicated for the uninitiated by a white line marked on the framework, the right adjustment of parts being further indicated by the appearance of an even disc of light upon the screen. A design is then inserted in the large stage, its lines of construction focussed, the analysing prism inserted in its jacket, and the coloured effect produced and varied either by the rotation of the prism or the rotation of the design or crystal.

By removing the panel from the support, and placing it before a window with nozzle pointing upwards, and adding a suitable power, it may be then used as a table polariscope, or the light of a reading-lamp may be employed as the source of light.

By this simplification of parts, Mr. Highley is enabled to supply an instrument—which for practical purposes can hardly be surpassed for efficiency—at one-half the price at which the gas polariscopes hitherto constructed have been sold. We fancy that many will appreciate this attempt to bring a costly instrument within the reach of experimentalists.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 4, 1864.

Professor T. Redwood, *Ph.D., in the Chair.*

The minutes of the preceding meeting were read and confirmed. Mr. James Duncan and Mr. T. J Glass were admitted Fellows of the Society; and Mr. J. Wrightson, M. Antonio Alves di Ferrara, and Mr. Charles Lambert, were balloted for and duly elected Fellows of the Society.

Dr. Odling read a paper, by Dr. How, "*On Mordenite, a Mineral from the Trap of Nova Scotia.*" The author referred to the previous labours of Messrs. Jackson, Alger and Gesner, who had described a great number of the interesting minerals of Nova Scotia. The subject of the present communication, Mordenite, had been so named from its occurrence in the vicinity of East Morden, in the Bay of Fundy. It did not offer much attraction to mineral collectors, for it rarely presented a crystalline appearance, but was usually found in the form of hard nodules or concretions, of an indistinctly fibrous structure, embedded in the trap rock, where it resisted well the disintegrating action of the weather. It was sometimes found underlying sulphate of baryta, and occasionally was associated with apophyllite. Mordenite belongs to the class of fibrous zeolites fusing without intumescence, and giving gelatinous silica, with hydrochloric acid. The author had analysed several specimens of the mineral, and the numbers so obtained pointed to a chemical constitution very similar to Haüylendite.

The Chairman, after moving a vote of thanks to Dr. How for his communication, announced that a series of special lectures would be delivered in the course of the present session (for programme, *vide* Chemical News, vol. ix., p. 60); but he was sorry to remark that, beyond a qualified promise on the part of Professor Kolbe to address the Society in April or May next, the Council had not been successful in inducing any eminent foreign chemist to accept their invitation.

The business of the meeting, which lasted in all only twenty minutes, was brought to a conclusion by adjournment until the 18th inst.

PHARMACEUTICAL MEETING.

Wednesday, February 3, 1864.

Mr. Sandford, *President, in the Chair.*

On commencing the business of the evening, the Chairman alluded to the recent publication of the British Pharmacopœia, and expressed a hope that the members of this Society would do their best to facilitate the introduction of the changes which had been made in the various preparations. A question had been put as to when it would be proper to begin dispensing the new preparations, and it had been suggested that Physicians should write "B.P." on prescriptions they wished to be dispensed according to the new formulæ; or "Ph. L.," if they intended the medicines to be compounded according to the old. Both of these plans he thought open to objection, since there must come a time when it would be necessary to entirely leave off dispensing the old preparations; for the present it was certainly necessary that both the old and new preparations should be kept by pharmaceutists.

Mr. C. Tomlinson then read a paper "*On the Verification of Castor Oil and Balsam of Copaiba by their Cohesion Figures.*" The author began with a general account of castor oil. This oil is obtained from the seeds of the *Ricinus communis*, which are either boiled in water and then pressed, or are pressed cold, to furnish the hot or cold drawn oils known in commerce. Much of this oil, of a good quality, and very cheap, is imported from Bombay, and the author believed he had been able to examine perfectly pure specimens from that presidency. A good quantity of the oil was also received from New York, and some from Australia. The seeds had also been imported from the East Indies, and the oil pressed out in this country. The plant was cultivated all over the East Indies to yield oil for burning; it was grown around their houses by the natives, who crushed the seeds, boiled them with water, and skimmed off the oil to burn in lamps. The largest quantity of the oil was imported from the East Indies, but in late years Italy had become a formidable rival. The machinery for obtaining the oil had been brought to great perfection in that country, and 45 tons of oil were obtained from 120 tons of seed. Castor-seed cake was in considerable demand as a manure for hemp-fields; and the oil, which is easily saponified, is made into soap, as well as used for burning. The plant was also cultivated in France, where it had been found that a plant from one seed would yield 900 seeds, which furnished half their weight of oil. But castor oil obtained from plants grown in temperate regions was found to be weaker than that procured from plants grown in the tropics. Some of the physical properties of castor oil were well known. It was a viscid, yellowish fluid, having a somewhat acrid taste, which varied somewhat according as the oil was freshly prepared or old. It remained fluid almost to 0° F., and was soluble in alcohol. The latter fact was considered a test for the genuineness of the oil; but Pereira found that castor oil had the property of promoting the solubility of oils in alcohol which alone were insoluble in that medium. Thirty per cent. of lard, nut, and other oils, in combination with castor oil, were found to be soluble in alcohol; and a mixture of one part olive oil, and two parts castor oil, gave, with two parts alcohol (sp. gr. ·860), a perfectly homogeneous solution. A concentrated castor oil was made by a small addition of croton oil, which could not be detected by chemical means, any more than the 30 or 50 per cent. of other oils which might be mixed with castor oil. Chemistry failing to detect these admixtures, recourse might be had to a physical test. This test depended upon the forces of cohesion, adhesion, and diffusion. A drop of the liquid to be tested was carefully dropped upon chemically clean water in a clean vessel. The force of adhesion endeavoured to spread the oil in a thin film over the surface of the water; the force of cohesion in the oil strove to prevent this; and from the contest of these two forces there resulted figures which the author believed to differ in the case of every independent liquid. There might be instances of two or more liquids differing in chemical composition, but having the same physical properties, and in these cases the figures produced on the surface of the water would be identical; such cases, however, must be rare. Since the cohesion figure depends on surface adhesion, it is necessary that the water should be chemically clean. Distilled water need not be used, New River water having been found to answer well. The vessel employed must be scrupulously clean. Simple washing and wiping with a cloth are not sufficient. The glass must be washed with strong sulphuric acid, then rinsed with water, again washed with caustic potash, and finally well rinsed with more water. The interior of the vessel should not be wiped. With regard to the shape of the vessel, the author had found a conical glass, having a diameter of four inches at the top, to answer well. The oil must be dropped on the water from a glass rod which has been cleaned in the same manner as the vessel described above. When the oil is dropped, the rod should be held about one-tenth of an inch from the surface of the water, so as to avoid splashing, and also in the cases of oils somewhat heavier than water—oil of cloves, for example—to avoid the influence of gravitation, which would immediately carry the drop to the bottom of the vessel. In general, only one drop should be allowed to fall, as the effects are not always the same; but in the case of a very volatile liquid, like ether, the figure of which lasts but a second, several drops may be dropped in succession from a tube as the figures disappear. So, also, in the case of creosote; but after the fourth drop this body ceases to give a figure, in consequence of the water becoming saturated. [Mr. Tomlinson described the cohesion figures of ether and creosote, and exhibited some beautiful drawings, without which the descriptions would not be intelligible to our readers. We can, therefore, only recommend our readers to make the experiment for themselves, and carefully observe the results.] The figures of the fixed oils are more durable, some lasting for several hours. This is the case with castor oil, the figure of which is of great beauty. As soon as this oil is dropped it spreads out in a series of rings, magnificently iridescent. Outside these is a silvery corona, which soon breaks up into a delicate lace-like pattern. This appearance lasts some hours, but eventually only a colourless disc of the oil is left. The same phenomena were remarked in all the castor oils examined. An important point to be observed in making these experiments is the temperature. The author has found the best temperature to be 60° F. How far the test could be applied to detect adulterations was yet hardly determined, since there was great difficulty in procuring undoubtedly pure specimens of oils from which to obtain standard figures. Mr. Tomlinson saw the oil expressed from linseed at the International Exhibition, and thought he had got a perfectly pure oil; but it turned out that other seeds were largely mixed with the linseed. There were other difficulties in the way. Oils differed somewhat according to the climate in which they were obtained, and the density of oil of lavender was known to differ in different years. Mixtures, however, could undoubtedly be detected. In these, the figures produced partake of the characters of both the constituent oils. A mixture of olive oil and sesame oil gives a figure which is at once that of neither, but both oils, yet most resembling that of the oil which is in excess. A mixture of lard oil with castor oil is best shown in what may be called the residual phenomena, the lace-like pattern being scattered over with numerous small blotches. Croton oil gives a magnificent figure of large pattern, and a mixture of 5 per cent. of this oil with castor oil may be readily detected by the practised eye. Turpentine gives a remarkable figure. The film flashes out immediately almost to the edge of the vessel, and the outer circumference is seen dotted with numerous small bosses, which are larger within, and enclose patches of iridescent colours. The pattern afterwards opens into holes, forming a network of great delicacy. For balsam of copaiba a good test was very desirable. The figure produced by the balsam was a magnificent sight. A succession of rings were thrown out, showing beautiful colours and a metallic lustre. A mixture of castor oil and balsam was instantly detected by the figure produced; neither colours nor border pattern was seen. In concluding, Mr. Tomlinson said he did not look on the investigation as complete. The subject was one that courted further examination, but he believed it would be found that every independent liquid produced a definite figure, which would serve for its verification, as the form of a crystal led to the identification of a salt.

In the course of the discussion which followed, Professor Miller said that, knowing the practical difficulties in the way of applying the test successfully, he could only recommend intending experimenters to pay particular attention to Mr. Tomlinson's remarks on the necessity for cleanliness. Every trace of grease must be removed from the glass and rod, or the results would be altogether vitiated.

Dr. Attfield inquired, whether the bed of liquid could not be varied, so that a single test might show mixtures of particular oils?

Mr. Tomlinson, in reply, said, his physical test was not a chemical analysis. He had tried several different beds, and always found different figures produced; but he had come to the conclusion, that water was the best surface and capable of the most general application. He might mention that the test had been submitted to some severe practical trials. A friend engaged in the oil trade had brought various specimens for examination, and was so convinced of the value of the test, that he remarked, "The oils write their names on water." In reply to a member, he added, that cod-liver oil gave a figure; but another experiment showed him that the specimen he had tried, when mixed with one-third fish oil, gave exactly the same figure. He also tried oil of spike, and obtained the same figure as with turpentine. On referring to a book, he found that oil of spike was made with four parts turpentine and one part oil of lavender.

Mr. Sanger then read a paper "*On the Process of Percolation as Applied to the Preparation of Tinctures,*" a report of which we postpone until next week.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 12, 1864.

J. C. Dyer, Esq., *Vice-President, in the Chair.*

The President, in the name of a number of members, presented to the Society a portrait of one of its Vice-Presidents, J. P. Joule, LL.D., F.R.S., by G. Patten, A.R.A., of London, and intended to be hung up on the walls of the meeting-room.

On the motion of Professor Christie, seconded by Mr. Atkinson, it was resolved, "That the best thanks of the Society be given to Mr. Binney and the other donors of Dr. Joule's valuable portrait."

Mr. John Rogerson was elected an ordinary member of the Society.

On the motion of Mr. Dyer, seconded by Mr. Sidebotham, it was resolved, "That the Society do hereby authorise the Council to procure a die for a medal, and to settle the design."

The following extract from a letter from T. T. Wilkinson, F.R.A.S., was read:—"On referring to the article 'Dodo,' in the *English Cyclopædia*, I find that Mr. Sidebotham is mistaken in supposing that his photographs exhibit 'the *earliest* figure of this now extinct bird.' The frontispiece of De Bry's '*Quinta Pars Indiæ Orientalis*,' A.D. 1601, contains 'a pair of these birds on the cornice on each side' of the ornamental border. Clusius, in his '*Exotica*,' A.D. 1605, also gives a figure, which he says is copied from the journal of a Dutch voyager, who had seen the bird in a voyage to the Moluccas in A.D. 1598. Mr. Buxton's '*Histoire*' appears to follow next in order; since the Journal of Admiral Peter Wilhelm Verhuffen, as quoted by the late Mr. Strickland, was printed at Frankfort, in A.D. 1613."

A paper was read by Henry E. Roscoe, B.A., Ph.D., F.R.S., entitled "*Note on the Amount of Carbonic Acid contained in the Air of Manchester.*" Determinations of the quantity of carbonic acid contained in the air of towns have been made by Dr. Angus Smith in Manchester, and by Lewry in Paris; but as the experiments hitherto made upon the subject are few in number, and have yielded somewhat remarkable results, it appeared of interest to carry out a series of determinations of atmospheric carbonic acid, made by unimpeachable methods, and extending for a considerable time, under wide variation of weather. The analytical method employed was the excellent volumetric one proposed by Pettenkofer, and this was checked in several instances by simultaneous weight determinations made by absorption in caustic potash. The close agreement of the results gives proof of the reliability of the methods. The experiments were made under my supervision by Mr. Arthur McDougall. In the case of the weight analyses, a given volume (not less than 35 litres) of air was drawn in the first place over three weighed tubes containing sulphuric acid and pumice-stone, the weight of the third tube being shown to remain constant; the air then passed through a Liebig's bulb containing potash; over two tubes containing solid potash; and, lastly, through two tubes containing sulphuric acid and pumice-stone, the weight of the second of these remaining constant. The volumetric analyses were made in globes of 7-10 litres' capacity, with standard solutions of baryta-water and oxalic acid, exactly according to the method described by Pettenkofer. The first and most important conclusion to which these experiments lead is that the amount of carbonic acid contained in Manchester town air differs but very slightly (if at all) from that contained in the air of the neighbouring country. Thus, from experiments made at Stretford (four miles west of Manchester) with the wind blowing towards Manchester, the quantity of carbonic acid found on Feb. 3, 1863, was 3·85 volumes in 10,000 volumes of air, as a mean of two experiments; whereas, on the same day, the quantity found in the centre of Manchester (Owen's College) was found to be 3·90 volumes in 10,000 volumes of air, as a mean of two experiments. Three experiments made at Stretford on Feb. 19, 1863, a damp day, with wind blowing from Manchester, showed a mean of 2·77 volumes of carbonic acid; whilst at Manchester, on the same day, the volume of carbonic acid was found to be 2·8 in 10,000 volumes of air. The maximum quantity of carbonic acid was found in Manchester air on January 7, 1864 (on which day there was a dense fog), when the amount reached 5·6 volumes per 10,000 of air; the minimum quantity on February 19, 1863, being 2·8 volumes per 10,000 of air. The mean of 46 determinations made in the centre of the town of Manchester, gives the volume of carbonic acid as 3·92 in 10,000, and that of eight experiments made outside the town gives the number 4·02 as the composition of the country air regarding carbonic acid. These numbers closely agree with a determination by weight which I made in London on February 27, 1857, from which the carbonic acid in London air was found to be 3·7 volumes per 10,000. Other experiments prove that continuous rain may lower the amount of atmospheric carbonic acid from 4·8 to 3·3 volumes per 10,000. The above results show that the maximum quantity of carbonic acid contained in Manchester air, even in a dense fog, and when there is no wind, does not exceed 6 volumes per 10,000 of air; whilst the mean quantity, 3·9 volumes, closely agrees with that (4·0) generally assumed, from Saussure's early experiments, to represent the average composition of the atmosphere as regards carbonic acid. Hence we may conclude that the combustion of coal and the respiration of animals exert no appreciable influence on the quantity of carbonic acid contained in the town air of Manchester collected in an open situation; gaseous diffusion and the great motions of the atmosphere serving completely to disperse the millions of tons of this gas which every year are evolved by the above-mentioned causes in this neighbourhood. I may add the following determinations, made in the same way, of the carbonic acid contained in the air of closed inhabited spaces:—

1. Chemical Theatre, Owen's College, during lecture.
   Temp. 9° C. Bar. 755 mm. CO_2 in 10,000 of air 9·5 vols.
2. Chemical Laboratory, Owen's College.
   9 o'clock a.m. Temp. 17·5°. Bar. 733·5. $CO_2 = 8·3$ vols. in 10,000.
   12 o'clock. Temp. 19·5°. Bar. 733·5. $CO_2 = 9·0$ vols. in 10,000.
3. Large bedroom, with invalid and attendant.
   Temp. 12°. CO_2 in 10,000 vols. of air = 7·4.
4. Parlour (capacity 3000 cubic feet), four persons, three gaslights, good fire.
   Temp. 19°. CO_2 in 10,000 vols. of air = 13·2.
5. Ditto ditto.
   Temp. 18°. CO_2 in 10,000 vols. of air = 13·6.
6. Ditto ditto.
   Temp. 15°. CO_2 in 10,000 vols of air = 14·5.
7. Crowded meeting-room of artisans in Penny's Mill, Gaythorn—Guardian Schools—1000 persons.
   Temp. 18°. CO_2 in 10,000 vols. of air = 36·5.
   CO_2 in 10,000 vols. of air = 35·5.

MICROSCOPICAL SECTION.

December 21, 1863.

Joseph Sidebotham, *Esq., President of the Section, in the Chair.*

Various valuable donations were announced, among others a paper by Walter Crum, Esq., F.R.S., "*On Cotton*

Fibre," accompanied with mounted specimens in illustration of it.

Mr. Heys repeated his observations on the cotton fibre, and said that there was little difference observable in cotton freshly gathered, from that as usually received in this country. His observations lead him to the conclusion that the structure of cotton fibre is as follows:—First, there is an external envelope, or tube, generally moniliform; inside, a spiral vessel which seems to prevent the collapse of the tube; inside the spiral there is generally present another substance like a pith or core. Mr. Heys then described at length his observations on the cotton when under the influence of the solvent recommended by Mr. O'Neil, and the conclusions he drew from them. Mr. Heys' paper was illustrated by diagrams and mounted specimens.

Mr. Heys then read a paper "*On Mounting Objects in Canada Balsam,*" and minutely explained the various details of the process: he strongly advocates the use of the Canada balsam, dissolved in chloroform, by which the trouble is lessened, and the beauty of the preparations increased.

The Secretary then exhibited a drawing of the apparatus used by Captain Baker, of the *Niphon*, for obtaining soundings free from grease.—Description: A tube 18 inches long, 1¼ diameter, with a wooden cap, and a leather, fitted as a pump-box; this, lashed to the lead, sinks into the earth, and brings up a cylinder of mud or sand, free from grease; the surplus water being forced out through the valve at the top.

ACADEMY OF SCIENCES.

February 6, 1864.

An important communication on "*Isomorphism*" was made by M. Maumené, who, after very careful experiments, has decided that no pyro- or meta-arseniates can be formed. We shall give an abstract of the paper next week.

M. Pagliari presented a note "*On a New Process for Preserving Animal Matters,*" in which he states, that a liquor composed of alum, gum benzoin, and water, will preserve animal matters for an indefinite time in the open air. The solution when dry forms a sort of skin, which protects the meat from the contact of air and "ferments."

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(eleventh notice.)

(Continued from page 58.)

In noticing the "Colouring Derivatives of Organic Matters, Recent and Fossilised," the author commences with the most important of the "recent," viz., madder and its derivatives. Madder, it is observed, has probably given rise to more researches and experiments than any other colouring matter, and yet our knowledge of it is extremely confused and uncertain. Whether there is more than one colouring matter in madder, or whether, indeed, there is anything more than a "colour-generating substance," are questions as yet undetermined. That there are differences in the chemical properties of madders of different countries, is well known, but "the conditions of these differences have not been traced with precision." The most recent researches lead to the supposition that fresh madder contains a bitter, colourless principle (*rubian*), probably a *glucoside*, which, by various methods, is transformed into alizarin, purpurin, and probably other products. This view is supported by a number of phenomena observed in practice, and, moreover, best explains Kopp's process for the economic preparation of alizarin and purpurin. Kopp's process is the following:—Ground madder is macerated with ten or twelve times its weight of water, containing 2 or 3 per cent. of sulphurous acid. The solution thus obtained is filtered, and the residue pressed. The solution contains the colouring matter. When mixed with 3 per cent. of sulphuric acid (sp. gr. 1·52), and heated to 30° or 40° C., purpurin is deposited. The mother liquor of the purpurin is now heated to boiling, when it gives off CO_2, and deposits alizarin, coloured greenish-black by foreign substances. This is collected and washed. The acid mother liquor is used for converting the exhausted madder residue into weak garancin. The above is certainly a simple and economic method of obtaining madder extracts, and deserves the attention of English manufacturers.

The properties of alizarin and purpurin are well known. The main distinctions between the two are, that purpurin is more soluble than alizarin in water, alcohol, and solutions of aluminium salts, and that it dissolves in alkalies, forming a liquid of a fine currant-red colour, from which the alkaline earths throw down red lakes. Alizarin, on the other hand, dissolves in alkalies with a violet colour, and forms violet blue lakes with the alkaline earths.

According to Strecker the formulæ of alizarin and purpurin are—

Alizarin . . .	$C_{10}H_6O_3$
Purpurin . . .	$C_9H_6O_3$

To these Dr. Stenhouse has lately added a third from East Indian madder, munjeet, and which he names munjistin—$C_8H_6O_3$.

We need not go further into the preparation of madder extracts by sulphuric acid or other means, which must be well known to our readers.

The colouring principles of lichens are rather shortly disposed of in the report, but an excellent account is given of French purple, which we extract at length:—

"French Purple.—This beautiful colour has been introduced and is chiefly manufactured by MM. Guinon, Marnas, and Bonnet, of Lyons (France, 167). It is prepared as follows:—The lecanoric, erythric, evernic acids, &c., of the lichens are extracted by digestion with ammonia; the mass is pressed, the solution precipitated by a mineral acid, and the precipitate collected, washed, and redissolved in ammonia by the aid of heat, whereby a solution is obtained, which, on exposure to the air at a temperature of 19° or 20° C., gradually assumes a very bright red colour. As soon as the tint has acquired sufficient intensity, the liquid is introduced into shallow basins, and very slowly evaporated at a temperature between 40° and 60° C., care being taken not to exceed the latter limit. By this evaporation in contact with the air, the liquid after a few days acquires a very deep violet colour, which undergoes no further change even by the action of acids. The violet solution, super-saturated with a strong acid, yields a copious flocculent precipitate of a very fine and rich garnet colour, which, when collected on a filter, and washed to remove the saline mother liquor, constitutes French purple.

"The dye thus prepared has not, however, attained the highest degree of beauty and purity of which it is susceptible. When used directly for dyeing wool or silk (for which purpose it does not require the aid of mordants, the colouring matter being simply dissolved in ammonia, and the solution diluted with the proper quantity of water), it imparts to them a violet colour having a reddish cast.

"To obtain the dye in a state of greater purity, it is converted into a lime or alumina lake. For this purpose, the ammoniacal solution is precipitated with chloride of calcium or with alum; the red colouring matter then remains almost wholly in solution, and the lakes are collected, carefully washed with cold water, and dried at a gentle heat. They then present a violet or bluish aspect, and acquire a coppery lustre by friction.

"French purple is generally sent into the market in the form of lime-lake. To render it available for dyeing, the lake is decomposed, and the colouring matter set free. For this purpose the lake is reduced to an impalpable powder, which is boiled with oxalic acid to separate the lime, and the colouring matter then dissolved out by ammonia. The lake may also be directly decomposed by boiling it with carbonate of ammonium. For printing, the lake is dissolved in acetic acid, and the solution mixed with alcohol, and thickened.

"In this manner, very fine and pure mauve and dahlia tints are obtained, especially on silk, without the use of mordants, properly so called. French purple, moreover, mixes easily with other colouring matters, such as ultramarine, indigo-carmin, cochineal, aniline-red, &c., producing the most varied and delicate tints.

"Recently, however, the manufacture of French purple has been greatly diminished in importance by the formidable competition of the coal-tar purple. The upshot of this struggle will depend on the relative beauty and purity of the tints obtained, and on their comparative cost; for, so far as regards fastness and resistance to the influence of light, French purple is certainly not inferior to aniline-purple."

A Handbook of Practical Telegraphy. By R. S. Culley, Telegraphic Engineer and Superintendent. London: Longman and Co. 1863.

Some of our readers will no doubt have noticed an advertisement in the *Times* a few weeks ago, inviting a number of young gentlemen to compete for appointments to work the Indian telegraphs. Now, supposing—though we are bound to say the supposition is a most absurd one—that the questions put to the candidates by the civil service examiners related to the business in which they would be afterwards concerned, Mr. Culley's is the very book to which intending candidates should give an attentive study in order to prepare themselves for the examination. It contains information on the construction and effective working of a line of telegraph, as well as a clear exposition of the science concerned; and Mr. Culley's long experience as a superintendent and engineer is a guarantee that the information is complete, and may be relied on.

NOTICES OF PATENTS.

2669. *Improvements in Deodorising Refuse Organic, Fæcal, and Urinous Matters; and in a Method of Utilising Coal and other Ashes; and in Machinery or Apparatus connected therewith, for producing a Portable Manure therefrom.* J. Harrop, Manchester, and J. Wadsworth, Salford. Dated October 3, 1862. (Not proceeded with.)

The inventors employ for disinfecting the matters named in the heading, common salt, either alone or in admixture with soot, ashes, or dried earth. From the materials so treated an excellent manure is manufactured by adding a small proportion of hydrochloric acid (to guard against the evolution and consequent loss of ready-formed ammonia), and evaporating to dryness either in open pans, or, more economically, in exhaust apparatus. With the product so obtained, the inventors prefer also to incorporate a quantity of common ashes and cinders of coal, such mixture constituting a manure of great efficacy, and one in which the relative proportions of animal and vegetable ingredients may be subject to modification according to the purpose for which it is required.

2712. *Preparation or Manufacture of Manure.* J. Beale, Maidstone, and M. A. Beale, Barnsbury. Dated October 7, 1862.

This invention is very similar to that just now described: the fæcal matters are mixed with soot, lime, common salt, and dregs of assafœtida. This last ingredient will, without doubt, have the effect of disguising the nature and origin of the matters entering into the composition of the manure, but it may happen that the odour is not thereby improved.

2718. *Treatment of Violet Colours derived from Coal-tar Oils.* P. Clavel, Paris. Dated October 8, 1862. (Not proceeded with.)

With the object of rendering the violet colours derived from coal-tar soluble in water, the inventor treats them with cold, fuming, Nordhausen sulphuric acid, employed in such quantity as to effect complete solution. The mixture is then gradually poured into water, and a current of steam passed through the diluted solution, and from this liquid the violet colouring matter is precipitated, either by adding common salt or by an alkali. Again, a current of steam is passed, and the ebullition thus maintained for about half an hour, by the end of which time the violet substance will have become flocculent, and may be easily collected on a filter and well washed. It is then in a fit state to be dissolved in boiling water to produce a solution which is at once applicable to the purposes of dyeing and printing.

It is probable that the several kinds of violet dye, although prepared from a common source, would exhibit differences in their degree of solubility when treated with sulphuric acid.

2726. *Manufacture of Paints or Pigments.* J. H. Johnson, Lincoln's-inn Fields, London. A communication. Dated October 9, 1862.

The patentee's first claim relates to the manufacture of pigments from finely-divided metallic copper, employing either that which has been fused and afterwards run into water, or otherwise divided, or the inventor takes electrotype deposits of a brittle kind and reduces them to powder. The second claim refers to the use of benzole as a solvent for gummy, resinous, or bituminous matters in the manufacture of paints and varnishes, and as a ready means of combining gums, resins, &c., with metallic or mineral pigments. The application of these substances to all kinds of surfaces hitherto coated with paint is mentioned under a third heading.

2756. *Improvements in the Manufacture of Silicate of Soda, or Silicate of Potash, and in the Manufacture of Artificial Stone.* C. Thomas, Bristol. Dated October 13, 1862.

For the purpose of aiding the solution of silica in the boiling potash or soda, the inventor has resort to a mechanical process, whereby the gelatinous coating first formed upon the exterior surfaces of the hard silicious particles is rubbed off by constant attrition, fresh surfaces becoming thus presented to the solvent action of the alkali. The apparatus used by the patentee consists of a close iron boiler mounted upon a horizontal axis, so that it can be rotated or oscillated, and it is preferred to apply heat by means of a steam-jacket fitted around the boiler.

The artificial stone is manufactured by treating with the silicate of soda certain waste products obtained in the process of making alkali, particularly the "black ash waste" and the "burnt pyrites." Either of these materials being ground to powder, and used singly or in admixture, is made into a stiff paste with a strong solution of the alkaline silicate, and whilst moist is shaped or moulded into blocks or bricks for building purposes. On drying, these substances form a hard stony material, which afterwards resists the action of water.

2837. *Cement.* J. Duke and J. Clever, Puriton, Somersetshire. Dated October 21, 1862.

This cement is prepared by calcining together lime and silicate of alumina in such proportions as to give a product not widely different in character from Portland cement. The inventors first calcine blue-lias limestone, mountain limestone, chalk, or other kind of carbonate of lime, in the ordinary kilns, until burnt to lime; this is then slaked and intimately mixed with finely-ground kaolin, slate-clay, potter's clay, fire-clay, or other material composed entirely or chiefly of silicate of alumina, such admixture being facilitated by stirring them up together with water, running off the top liquid, and allowing the particles afterwards to settle by standing at rest. When they have thus subsided, the water is run off, and the white deposit collected, dried, and burnt until a double silicate of alumina and lime is formed; the product is then ground to a fine powder, and in this state constitutes an excellent cement.

Grants of Provisional Protection for Six Months.

209. Charles Bolton, Moreton Street, Pimlico, London, "Improvements in apparatus for producing optical illusions, which may be used for dramatic and other entertainments."—Petitions recorded December 19, 1863.

259. Nathaniel Lloyd and Edwin Hargraves, Church, near Accrington, "Improvements in treating printed and dyed fabrics."—Petition recorded December 24, 1863.

23. Auguste Lucien le Harivel, Tweedmouth, Northumberlandshire, "Improvements in the manufacture of paper, papier mâché, cardboard, and other similar articles."

30. Joseph Judge Hays, Hitchin, Hertford, "Improvements in the manufacture of peat, charcoal, and in the apparatus employed therein."

63. William Clement Beatson, Rotherham, Yorkshire, "Improvements in furnaces employed in the manufacture of certain descriptions of glass, and also improvements in the manufacture of plate glass."—Petitions recorded January 9, 1864.

Notices to Proceed.

2203. Ludwig Mond, Appleton, Widness, Lancashire, "Improvements in obtaining sulphur and sulphurous acid from 'alkali' waste."

2252. John Adams Whipple, Boston, Massachusetts, U.S., "Improvements in apparatus for supporting photograph cameras."—Petitions recorded September 12, 1863.

2255. Thomas Bell, Wishaw, Lanarkshire, N.B., "Improvements in apparatus for distilling shale or other bituminous minerals."

2256. George Whitfield Billings, New York, U.S., "An improved method of preparing the fibres of hemp, flax, and other vegetable materials for manufacturing purposes."—Petitions recorded September 14, 1863.

CORRESPONDENCE.

Oleum Coriandri.

To the Editor of the Chemical News.

Sir,—In the Ph. B., page 339, in the formula for Syr. Sennæ, you will find 3 minims of Ol. Coriandri ordered in 2 lb. 10oz. by weight, which is 1 minim in 14 oz.; the maximum dose of the P.L., 1851, was ʒss.; and if this quantity is still given, the quantity of the oil, you will perceive, is a mere trifle. I am, &c.

Alex. Gow.

Wolverhampton, February 6.

The Red and White Rocks of Hunstanton.

To the Editor of the Chemical News.

Sir,—My attention has lately been drawn to the above red rocks. In the course of my examination, I intensely magnified a portion, and noticed it to contain small, shelly-like globules of different colours,—white, black, and some resembling in colour tortoise-shell, predominating.

To show the very minute size of these, I may say, that when a sample is pounded to its finest in an agate mortar and magnified, these globules still remain, and show themselves unbroken. In the Chemical News for the last week of the year 1861, I see Mr. Clapham has given the analysis of both the red and white chalk. Perhaps he, or some other gentleman, can enlighten me as to the nature of the above observation. I am, &c. C. W.

P.S.—I may as well also state that the sulphuric acid in my sample, is in larger quantity than the amount Mr. Clapham gives in his analysis.

MISCELLANEOUS.

BRITISH PHARMACEUTICAL CONFERENCE.

The annual meeting of the members of the British Pharmaceutical Conference, which, it will be remembered, is an organisation chiefly for the encouragement of scientific inquiry into matters connected with pharmacy, will this year be held at Bath at the time of the visit of the British Association to that city. Of the subjects suggested for investigation, the following have been accepted, either by the gentlemen who proposed them, or by other members; and a paper on each question (or an abstract of the paper if the author shall have previously published his results) may be expected to be read at the meeting:—

Extract of *Fucus vesiculosus* is occasionally prescribed for use in medicine. When made by the action of proof-spirit, a green product is obtained; when by water, a red extract results. What is the most eligible form in which to exhibit any medicinal principles that may be present in the plant? Accepted by J. Whitfield.

Valerianate of Zinc. Describe an easy method of determining the purity of this salt as found in commerce. Accepted by F. Sutton.

Valerianate of Iron. What is the best process for the preparation of this salt? What are its characters, and how may its purity be most readily ascertained? Accepted by F. Sutton.

Syrup of Senna. Devise a formula for this preparation which shall afford a syrup less prone to ferment than that of the London Pharmacopœia. Accepted by J. A. Knights.

Methylated Spirit. Required, an easy method of detecting methylic alcohol in the presence of ethylic alcohol. Accepted by J. Tuck.

To what extent is dialysis applicable in determining the nature of the crystalline constituents of plants? Accepted by J. Attfield.

Report on the applications of Glycerine in Pharmacy. Accepted by F. B. Benger.

What is the quality of the diluted solution of Phosphoric Acid met with in commerce, and what the best and safest method of obtaining it of constant strength? Accepted by R. Parkinson.

Ergot. What is its active principle, and what the best preparation for its administration? Accepted by R. V. Tuson.

Cusparine, in the *Cusparia febrifuga*. Mr. Haselden undertakes to make a communication on this subject.

Euphorbine, in the Euphorbia. Professor Tuson will add to some experiments he has already made on this substance, and report the result to the Conference.

Hyoscyamine. Mr. Tilden engages to add to our knowledge of this alkaloid.

Pereirine, in the bark of *Geissospermum Velosii*, Allem. Dr. C. A. Martius will communicate a paper on this body.

Some of the pill masses of the Pharmacopœia are of inconvenient consistence, or acquire that condition by keeping; can this be obviated? Accepted by E. Wood.

Concentrated Infusions. Required, processes which will yield stable products that give on dilution infusions resembling those of the Pharmacopœia, and which can be conducted with facility on the small scale. Accepted by T. Grundy.

Podophyllin. What is the nature of the commercial article, and what process will yield a definite substance? Accepted by J. Spearing.

Report on processes for the separation and estimation of alkaloids in medicinal extracts, &c. Accepted by T. B. Groves.

Report on the modes of preventing the rancidity of medicinal fats. Accepted by T. B. Groves.

Report on the weights and measures used in pharmacy. Accepted by B. S. Proctor.

On microscopic analysis applied to pharmacy. Accepted by H. Deane and H. B. Brady.

To what does Senna owe its active properties, and what is the best solvent of the same? What is the comparative medicinal value of senna leaflets and senna-pods? Accepted by J. A. Knights.

What is the quantity of Tannin in English Galls (*Cynips quercus-petioli*) at different stages of their growth? Can they at either of these periods be employed economically as a substitute for the nut-galls of commerce? Accepted by W. Judd.

Steel Wine. What is the best method of obtaining this preparation of uniform strength and appearance, and what the quality of commercial specimens? Accepted by F. Sutton.

Potentilla Tormentilla. Mr. Adams will send a paper on this drug.

Subjects relating to Adulterations, Impurities, and Faults of Manufacture.

Iodide of Potassium. A large quantity of this salt is now imported from the Continent; what is its condition as to purity? Accepted by F. C. Clayton.

Carbonate of Bismuth of commerce is said to contain a large proportion of nitrate; what is the general composition of this article, and what the best method of its preparation in the pure state? Accepted by C. Umney.

Large quantities of cotton-seed oil are expressed in this country, and exported to Italy for admixture with olive oil. What are the properties of cotton-seed oil, and can it be used in pharmacy? Accepted by R. Reynolds.

Essential oils, their adulterations by turpentine, and tests of purity. Accepted by H. S. Evans.

Report on the purity of the simple and compound powders used in medicine. Accepted by F. M. Rimmington.

Report on the strength of diluted and undiluted officinal acids. Accepted by S. Paine.

Report on the strength of the alkaline solutions (Potash, Ammonia, &c.), met with in pharmacy. Accepted by S. Paine.

Report on the various James's Powders. Accepted by W. T. Fewtrell.

The composition of the bottled mineral waters of commerce. Accepted by H. Matthews.

On the Calamine and Oxide of Zinc of pharmacy. Accepted by R. H. Davis.

Report on the purity of commercial iodides and bromides, other than the iodide of potassium. Accepted by H. Matthews.

Report on the strength and condition of such mercurial preparations as mercury with chalk, mercurial ointment, &c. Accepted by J. Coupland.

Report on the purity of Sulphate of Quinine of commerce. Accepted by W. W. Stoddart.

Report on the strength of tinctures as met with in pharmacy. Accepted by W. D. Savage.

On the quantity of alkaloid in various specimens of citrate of iron and quinine. Accepted by T. B. Groves.

The Morphia salts of commerce. What is their state of hydration and moisture? Does the hydrochlorate often contain codeia? Accepted by W. E. Heathfield.

A committee of five gentlemen—Dr. Attfield, of London; Mr. T. B. Groves, of Weymouth; Mr. B. S. Proctor, of Grey Street, Newcastle; Mr. F. M. Rimmington, of Bradford; and Mr. F. Sutton, of Bank Plain, Norwich—has the general charge of these subjects relating to the purity of medicines. Either member of the committee will be glad to receive directly, or through the general secretaries, authentic specimens of substances whose examination would tend to throw light on the questions. The analysis of such specimens will be free of cost.

A committee to consider the subject of the prevention of accidental poisoning has also been formed. It is composed of Mr. J. R. King, of High Street, Bath; Mr. J. H. Marsh, of Milsom Street, Bath; and Mr. F. W. Kent, of Saville Row, Bath, either of whom will receive suggestions on the subject.

Every member of the British Pharmaceutical Conference is expected to suggest subjects for investigation, or to work upon subjects suggested by himself or by others, or to contribute information tending to throw light on questions relating to adulterations and impurities, or to collect and forward specimens whose examination would afford similar information, or in some other way to aid in the advancement of pharmacy. Any new facts that are discovered during an investigation may be at once published by an author at any meeting of a scientific society, or in any scientific journal, or in any other way he may desire. He is expected, however, to send a short report on the subject to the annual meeting.

The current list of subjects requiring investigation is sent to members immediately after their election, and a new list immediately after every annual meeting. The list for 1863-4, containing several questions at present unaccepted, can be obtained of either of the Honorary General Secretaries—Dr. Attfield, 17, Bloomsbury Square, London, E.C., and Mr. R. Reynolds, F.C.S., 13, Briggate, Leeds; or of the Local Secretary, Mr. J. C. Pooley, George Street, Bath.

The annual meetings will always be held in the provinces, and probably at the time and place of the visit of the British Association. Gentlemen desiring to join the Conference must be nominated by two members. The yearly subscription is five shillings, due in advance, on the 1st of July.

Death of Heinrich Rose.—We regret to announce the death of this distinguished analytical chemist. He died at Berlin, on the 29th of January, aged 69.

Royal Institution.—Tuesday, February 16, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Thursday, February 18, at three o'clock, Professor Tyndall, F.R.S., "On Experimental Optics." Friday, February 19, at eight o'clock, W. S. Savory, Esq., F.R.S., "On Dreaming and Somnambulism." Saturday, February 20, at three o'clock, Professor Frankland, "On the Metallic Elements."

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

S. P.—Both notations are used. The price is 10s.

Magenta will have some information on the subject next week.

J. Y. (*Glasgow*), should apply to Messrs. Simpson, Maule, and Nicholson.

J. D.—Next week.

W. L. Carpenter.—Received with thanks. The Report is postponed for woodcut.

A Young Student.—The atomic weights of the metals cannot be considered as yet settled. You had better be guided by the last edition of Fownes'.

Subscriber.—The amount of iodine in sea-water is inappreciable. Its presence therein is inferred from its presence in sea-weeds.

G. N.—The formulæ are correctly copied from the Report, in which the new notation is followed. In this notation the formula for water is H_2O, for phosphoric acid, H_3PO_4, and for sulphuric acid, H_2SO_4.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Non-Existence of Pyro- and Meta-Arseniates, by M. E. J. Maumené.*

It is said by Mitscherlich, that when acids and bases are combined in the same degree of saturation, they not only show the same crystalline form, but possess the same chemical properties. He has also asserted, that every arseniate has a corresponding phosphate, composed of the same proportions, combined with the same number of atoms of water of crystallisation, and possessing, at the same time, the same physical properties; in a word, the two series of salts differ in nothing but this—that the radical of the acid of one series is phosphorus, and of the other arsenic. This has been accepted as the expression of a natural law, and the most recent works on chemistry consent to this pretended law. "It is probable," say MM. Pelouze and Frémy, "that these salts (the arseniates) undergo, when heated, the same changes as the phosphates."

It is no such thing: arseniate of soda never gives either pyro-arseniate or meta-arseniate. Submitted to an intense heat, suddenly or carefully, or prolonged for some hours, it does not undergo the slightest change of the sort. Dissolved in water, and then mixed with a solution of silver, it always gives a brick-red precipitate of $AsO_5,3AgO$.

I prepared the acid by Gay-Lussac's method; this acid, neutralised with soda, and evaporated, gave, on cooling, a confused mass; after draining on a filter, and re-dissolving in water, the second solution, properly concentrated, yielded beautiful crystals of the formula $AsO_5,2NaOHO + 24HO$. These crystals heated to redness lost, in one experiment, 55·58; and in another, 55·87 per cent. of water. 25 HO corresponds to 55·97, and 24 HO would give 54·96 per cent. These results were verified by M. Setterberg.

The crystals were submitted to a full red-heat; the fused mass was dissolved, and the solution added to nitrate of silver. A precipitate of the well-known colour was produced, which, washed and dried, gave, on analysis, 74·1 and 74·3 per cent. of silver. $AsO_5,3AgO$ gives 75·1, and $AsO_5,2AgO$ would give 66·86 per cent. of silver.

Arseniate of soda fuses below 100° C.; kept at this temperature for a long time it becomes a gummy mass, which solidifies when agitated, and then is somewhat like stearic acid in consistence. I have kept the salt in this condition for several days, and at the end of the time have precipitated it with nitrate of silver. The arseniate of silver was brick-red, and yielded 75·11 per cent. of silver. The salt heated briskly to redness gave the same result—75·2 per cent. of silver.

I have maintained the arseniate of soda at a red-heat for several days in a glass furnace, and its properties have not been altered. To vary as much as possible the conditions of the experiment, I have employed the acetate in place of the nitrate of silver; but the brick-red precipitate always presented the same composition.

Arseniate of potash seemed to offer a chance of procuring meta-arsenic acid. I prepared this salt from an acid obtained by Gay-Lussac's method, and also from acid made from arsenious acid and aqua regia. The arseniate of potash was submitted to a red-heat, varying the conditions, as with the arseniate of soda, but the final results were constant, as before.

Lastly, the author experimented with the arseniates of baryta and lead, which, after the same treatment, gave a silver salt of exactly the same composition as was obtained with arseniate of soda.

TECHNICAL CHEMISTRY.

On the Influence of Fluxes on the Composition of Manganiferous Cast Irons, by M. H. Caron.

In a recent note* I showed by experiments, supported by analyses, that manganese served, in cast irons, to expel sulphur, and often silicium; I added, that sulphurous and silicious cast iron might be improved by cast irons charged with manganese, which would be the more valuable according to their richness in manganese. Consequently, it would be well to possess means of extracting from the ore the cast iron most charged with this purifying metal.

There are two causes, all other things being equal, which singularly influence the amount of manganese contained in cast iron:—1st. The flux employed in the reduction of the ore. 2nd. The temperature at which this reduction is effected. I have ascertained the effects of these two causes by experiments, of which I will here give some description.

The ore on which I operated was a carbonate of iron and manganese, having the following composition:—

Carbonate of iron	71·0
Carbonate of manganese . .	13·3
Carbonate of magnesia . . .	11·2
Carbonate of lime	0·2
Silica (quartz)	4·3
	100·0

Several kilogrammes of this ore were finely pulverised and perfectly mixed together. In each of the assays, of which I shall give you the results, I used the same quantity of this ore; the wood charcoal mixed with the ore was in each instance used in the same way: finally, all the crucibles were brasqued with a mixture of graphite and molasses or coal-tar.†

The following table shows the kind and the quantity of flux used per cent. of ore, and the colour of the cast irons obtained, as well as their richness in silicium and manganese. In the experiments from Nos. 1 to 5, inclusive, the temperature employed for the reduction was always decidedly the same;—the temperature for No. 6 was as low as possible (high enough, however, to allow the cast iron to collect). In assay No 7, on the contrary, the heat must have been great enough to melt several hundred grammes of soft steel:—

No.		Colour of the cast iron.	Manganese per cent.	Silicium per cent.	
1. Carbonate of lime .	10	White	7·93	0·05	
2. Carbonate of lime .	5	White	6·32	0·08	
3. Fluoride of calcium .	5		4·70	0·30	
4. Silicious earth . .	5	Grey	3·81	0·55	
5. Silicious earth . .	10	Very grey	2·25	0·76	
6. Silicious earth . .	5	Grey	3·90	0·50	Low temp.
7. Silicious earth . .	5	Grey	2·10	0·75	High temp.

Assays Nos. 1, 2, 3, 4, and 5 show that, to obtain cast iron rich in manganese from a given ore, as much lime must be used as can be introduced without spoiling the fusibility of the slag. It will be found, on the contrary, that the proportion of manganese diminishes as the

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* Abstracted from *Comptes Rendus*, t. lviii., p. 250.

* *Comptes Rendus*, 1863, p. 828.

† This brasque resists admirably, even in the reduction of manganese; but the graphite, before being used, must be freed from all foreign matters (about 4 or 5 per cent.), and especially from sulphur, of which it contains more than 1 per cent.

silicious flux increases, and what is remarkable, that, as the manganese disappears, silicium takes its place in the cast iron.

The temperature used for the reduction also exercises a notable influence on the richness of the cast iron in manganese. Assays 6 and 7 show that the higher the temperature the less manganese, but the more silicium, will be found in the cast iron. As in the preceding experiments, silicium and manganese seem mutually to exclude one another.

It will not be uninteresting to observe the nature of the cast irons obtained. A sufficient quantity of lime produces white cast irons, while silica produces grey. By simply changing the flux, we may then obtain it at will, either white or grey steel or iron, or cast iron.

I will not further enlarge upon these results; they are such as can be perfectly appreciated by metallurgists. I speak now of cast irons obtained with iron ores containing oxide of manganese or mixtures with it. Lime has not exactly the same influence on non-manganiferous ores; but the question should be treated in a special manner, and I trust soon to be able so to treat it.

The assays, the results of which I have laid before the Academy, are only laboratory experiments, but still I hope they may prove of some service. Thus, ironmasters who mix ores rich in manganese with their ordinary ores (sulphuretted or silicated), for the purpose of ameliorating their products, may without fear gradually increase the usual quantity of flux without seriously diminishing the liquidity of their slag. If the flux thus modified becomes too refractory, the addition of sea salt or chloride of calcium soon gives them the desired amount of fusibility.‡ In this case, fluor-spar or cryolite§ will produce the same effects; but as these bodies, especially the latter, always contain notable qvantities of phosphoric acid, which is very destructive to cast iron, the greatest care must be taken in using them.—*Comptes Rendus*, lvii., 786. 63.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

(Continued from page 77.)

Having concluded a hasty review of most of the novelties introduced into the British Pharmacopœia, we proceed to notice the changes made in the various preparations, and on mature consideration take them in alphabetical order instead of classes, as at first seemed advisable.

We have noticed the substitution of French for British vinegar. The former article was already officinal in the Dublin and Edinburgh Pharmacopœias; and is, perhaps, better adapted for pharmaceutical purposes than vinegar made from malt, since it is less liable to change.

Acetic acid offers an example of the value of one Pharmacopœia for the United Kingdom. Under the three Colleges we had acids of eight different strengths prescribed. These have now been reduced to three—*Acidum Aceticum Glaciale*, *Acidum Aceticum*, and *Acidum Aceticum Dilutum*. Glacial acetic acid might as well have been omitted. Its employment in a single preparation (mist. creosoti) is a mistake. The acid will, no doubt, dissolve the creosote, but a separation will take place on the addition of the water.

The process given for the preparation of glacial acetic acid is of doubtful utility. Very careful experimenters inform us that they have failed to procure a crystallisable acid by the process; and, moreover, it could not be applied to the production of the article on any considerable scale. All the glacial acid consumed in this country is imported from the Continent, where it is produced at a cheaper rate than in this country. By what process it is made is not well known here; but we have reason to believe that that we quoted from the International Report (see page 58) is largely employed. At all events, a crystallisable acid is easily obtained by this process, which is besides very manageable.

Acidum Aceticum is still the purified pyroligneous acid, but the strength has been slightly diminished. The Dublin preparation, which has the sp. gr. 1044, and contains 28 per cent. of real acetic acid, has been adopted in place of the former London acid, which had the sp. gr. 1048, and contained 30·8 of real acid. For this acid pharmaceutists will have to rely on the manufacturers; and since the dilute acetic acid is now to be made with one part of acid to seven of water, it is to be hoped that Messrs. Beaufoy, the great producers of this article for pharmaceutical purposes, will at once increase the strength of their "one to seven" acid, to meet the requirements of the Pharmacopœia.

The new process for citric acid, the novelty in which consists in submitting the juice to fermentation before precipitating the acid by means of chalk, is one which we believe has long been followed by makers of the acid on a large scale. A good deal of the vegetable matter is got rid of by the fermentation, and the juice is clarified by the subsidence of the yeast.

This process, like a good many others, might as well have been omitted from the Pharmacopœia, the bulk of which is unnecessarily swollen by directions for the manufacture of articles which are found in commerce in a state of perfect purity. The same remark applies to the processes for benzoic and gallic acids, neither of which will be followed literally by any experienced maker of those acids.

The reader will observe that the strength of all the mineral acids has been altered. All the strong acids are to be made stronger, and the dilute acids likewise, with the exception of dilute sulphuric acid. The changes will be best shown by exhibiting the specific gravities in a tabular form :—

	London, 1851.		British, 1864.	
	Strong.	Dilute.	Strong.	Dilute.
Acidum Hydrochloricum	1·160	1·043	1·170	1·050
,, Nitricum . .	1·420	1·082	1·500	1·101
,, Sulphuricum .	1·843	1·103	1·846	1·087

We have already noticed the singular omission to direct the application of heat in the process for hydrochloric acid, which otherwise calls for no remark. The increase in the strength of nitric acid, from 1·42 to 1·5, is decidedly objectionable. The alteration appears to have been made because it was thought advisable to introduce a form for the preparation of gun-cotton, which might as well have been omitted; and perhaps, also, because the acid of the Dublin and Edinburgh Colleges was 1·5. Nitric acid of this strength is not easily prepared on the large scale, and the transport is dangerous, since, if a carboy should be broken, the straw surrounding it will almost inevitably become inflamed. The acid will probably be often made by re-distilling a weaker acid with sulphuric acid, than by the directions given in the

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‡ By treating the residues of the fabrication of chlorine by carbonate of lime, a liquid will be obtained containing chlorides of manganese and of calcium. This liquid, freed by filtration or decantation from arsenic and phosphorus, and then dried, would be a valuable flux if it could be cheaply obtained.

§ Fluor-spar and cryolite always produce a much larger yield of cast iron.

Pharmacopœia, where it is omitted to be stated that a retort capable of holding twice the amount of the ingredients should be employed.

In the preparation of sulphuric acid, the commercial acid is directed to be re-distilled with sulphate of ammonia. The object of this is to get rid of the nitrous compounds which are in general found in the commercial acid; lead will be found in the residue, and also any arsenic which may be present, the latter in the form of arsenic acid, that is, if nitrous compounds were originally present. On this point we may call attention to a paper in our last number. The distillation of sulphuric acid requires a great heat, and the operation can only be performed with small quantities at one time, and even then the liability to accident is very great. The process is unquestionably satisfactory; but such an acid as the Pharmacopœia contemplates will, no doubt, be oftener found in the laboratory of an analytical chemist than the store of a pharmaceutist.

The dilute mineral acids, as we have said, are all more or less altered in strength. They have, indeed, in one sense, been reduced to an uniform strength, that is, six fluid drachms of each now contain an equivalent in grains of the respective acids. We do not see the advantage of this, either to the prescriber or dispenser; but it affords a ready means of ascertaining the strength of the acid by the help of the volumetric method of acidimetry which is now applied in the Pharmacopœia, and which we may here refer to, so far as it is used in the determination of acids. Soda is very properly chosen to form the normal alkaline solution, which, after Mohr's system, is to contain one equivalent in grains (31) in 100 measures of the solution. The details of the operation we need not describe, since most of our readers must be acquainted with this method of analysis, and the directions of the Pharmacopœia are clear and intelligible.

Dilute phosphoric acid has been increased in strength, the new acid having a density of 1·08, while that of the old was only 1·064. In this instance six fluid drachms will only contain half an equivalent in grains of real phosphoric acid. A porcelain basin is now directed to be used in evaporating down the acid, a platinum vessel being quite unnecessary, unless the evaporation is to be carried much further than is directed in the Pharmacopœia.

The directions for the preparation of *Acidum Hydrocyanicum Dilutum* may be said to be identical with those in the London Pharmacopœia, and the acid is to be of the same strength, viz., with 2 per cent. of real acid. This, it is pointed out, is only little more than half the strength of the acid of the Edinburgh College—dilute hydrocyanic acid formerly meaning an acid with 3·8 per cent. of real acid on one side of the Tweed, and, on the other, with only 2·0 per cent.!

The strength of this acid is directed to be determined according to Liebig's method, by means of a normal solution of nitrate of silver, added to an alkaline solution of the acid.

Half a fluid ounce of the acid treated with an excess of soda should require 80·66 measures of the solution of nitrate of silver, which is to contain 17 grains, or $\frac{1}{10}$th of an equivalent, in 100 measures. Upon dropping the silver solution into the dilute hydrocyanic acid, rendered alkaline by soda, no permanent precipitate is produced until all the cyanogen of the acid has combined with the alkali and silver to form a soluble double salt, NaCy,AgCy. The smallest excess of silver beyond the quantity required to form this compound, occasions a permanent precipitate of cyanide of silver, the double compound being destroyed. The mixture must be constantly stirred as the silver solution is added, and the first appearance of permanent turbidity carefully noted.

We may here recommend all our readers to determine the strength of their *Aqua Laurocerasi* in the same way.

On the Relative Activity of American and European Aconite Root, by WILLIAM PROCTER, *Jr.*

AT the meeting of the Association held in Philadelphia September, 1862, the following query was accepted by me:—"What is the relative activity of the root of *Aconitum napellus* grown in the United States and that imported from Europe, based on their yield of aconitia; and what objections, if any, exist to the economical culture of the plant in the United States." Soon after the meeting adjourned, a letter was addressed to Messrs. Tilden and Co., of New Lebanon, New York, who cultivate aconite for making the extract, requesting their aid in obtaining a sufficient quantity of the American grown root, to make the comparison. The very early setting in of the winter interfered with their getting the root, and it was not until early spring, when the frost left the ground, that they could have it gathered. It was then carefully dried. The quantity received was rather more than a pound avoirdupois. So carefully had the roots been removed, that the fibres were mostly remaining; the main roots varying in diameter at the caudex from a quarter to three-quarters of an inch, and from three to six inches in length, including the tap root. The colour of the epidermis is purplish brown, inclined to black on the older portions, and the odour is rank, and somewhat like that of opium.

After carefully drying the aconite it was ground to moderately fine powder. 5000 grains of this were macerated for two weeks,* in sufficient alcohol, sp. gr. ·835, to moisten it, then packed into a glass percolator, and slowly percolated with alcohol until five pints of tincture had passed. The percolate was placed in a retort, and, by aid of a water-bath, four pints of alcohol were recovered, and the residue evaporated to four fluidounces. To this a fluidrachm and a half of diluted sulphuric acid mixed with a fluidounce of water was added, and the whole evaporated to two fluidounces and a half. The residue was syrupy in consistence, with oleoresinous globules floating on it, with a decided acid reaction. The aconitia being in the state of sulphate, and hence insoluble in strong ether, the liquid was agitated with two fluidounces of washed ether to remove the oleoresin; after decanting, the washing was repeated. The aconite liquor was now treated with an excess of solution of ammonia to liberate the aconitia, and the alkaline mixture washed by agitation and decantation with three separate portions of ether, of two fluidounces each. The ethereal liquids, united, were evaporated spontaneously in a tared capsule: the residue weighed sixty grains, and was dark coloured, strongly alkaline and not entirely hard, owing to a little oleoresin present that had not been completely removed by the preliminary washing. The impure mass was mixed with a fluidounce of distilled water, and diluted sulphuric acid carefully dropped in, with the application of heat, until the acid ceased to be neutralised, and the liquid remained slightly acid. A residue of dark brown oleoresin remained. The fact of this occurring shows the importance of well washing the solution before separating the aconitia. The solution of impure sulphate of aconitia

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* This long maceration was rather accidental than intentional.

was now filtered, and the filter carefully washed. The filtrate weighed 585 grains troy. To ascertain the aconitia strength of this liquid, it was assayed by the process of Prof. F. F. Mayer (*Amer. Jour. Pharm.*, vol. xxxv., p. 23), with iodohydrargyrate of potassium. Five grains of this solution diluted, required sixty-eight grains of the test liquor, a preliminary trial having been made to get an idea of the strength of the solution. Then as 68 grains of test liquor represent ·36312 grains of aconitia present in 5 grains of the solution of sulphate of aconitia, therefore 585 grains equal 42·483 grains of aconitia from 5000 grains of the root, or nearly 0·85 per cent. $(585 \div 5 = 117 \times {\cdot}36312 = 42{\cdot}483)$.

The residual liquor, after the extraction of the aconitia, was then treated with an ounce of chloroform and a little more ammonia; but, owing to the ether present and the density of the extractive solution, it did not separate. To effect its separation, sufficient ether was added to make the mixed chloroform and ether lighter than the extractive solution, when it was decanted, evaporated, and heated with a fluidounce of water. The addition of diluted sulphuric acid liberated a bulky hydrated oleoresinous precipitate, which, on standing, gradually lost its water of hydration, and assumed a soft consistence, staining paper. The liquor from this precipitate, with its washings, was tested for aconitia, and 4·065 grains more of the alkaloid indicated, making the whole, according to Mayer's test, 46·56 grains.[†]

European Aconite Root.—A parallel experiment was now tried with European aconite root of German origin; 5000 grains of this root, in moderately fine powder, were treated in a similar manner with alcohol, sp. gr. ·835. The liquor concentrated to three fluidounces, mixed with a quantity of diluted sulphuric acid, equal to that employed in the first experiment, and then washed with ether until the latter ceased to be coloured. The aconitic liquid separated from the ether was mixed with an excess of ammonia, and again treated with ether till exhausted. The ethereal liquids left, on evaporation in a capsule, 30 grains of soft brown residue strongly alkaline to test paper. This, when treated with a fluidounce of water, and sufficient diluted sulphuric acid, all dissolved but a trace, showing that the more thorough preliminary washing in this instance had removed all the oleoresin. The impure solution of sulphate of aconitia weighed 686 grains. Five grains of this required 30 grs. of test liquor to saturate it. $686 \div 5 = 137 \times 0{\cdot}1602 = 21{\cdot}94$ grains.

The residual aconite liquor was treated with chloroform, ammonia, and ether, as in the other experiment. A few grains of soft extract only were obtained, exhibiting, when properly treated, but a faint cloudiness with the test solution for aconitia.

The ethereal washing liquids, containing fixed oil and resin, were separately evaporated. The product from the American root amounted to 114 grains; whilst that from the European root equalled 180 grains.

The two solutions of sulphate of aconitia were now treated to isolate the alkaloid. That from the European root was carefully precipitated by ammonia, the precipitate collected on a filter, washed and dried. It weighed ten grains.

The solution from the American root was then precipitated by ammonia, and the liquid and precipitate washed with ether to remove the aconitia. The ethereal liquid, on evaporation, left the aconitia somewhat gelatinous, and, on standing, decided evidences of crystallisation were manifested. Most of the alkaloid dried in a resin-like form of a yellowish colour, which, in powder, had a light straw colour, and weighed 21 grains.

Aconite has fewer enemies among the insect tribes than any of the ordinary narcotics or sedatives, not being preyed on by the slug, so destructive to hyoscyamus and belladonna. The soil should be deep, and well manured with animal manure, and the plantation kept clean. The roots should be dug late in the fall, and then thoroughly dried.

From the foregoing parallel experiments, it would appear that aconite roots grown in America are stronger in aconitia than are the commercial European roots. The sample of European aconite used was, so far as could be judged by external appearance, a fair specimen, and, medicinally, had given satisfaction. In all the papers that I have examined, from that of the discovery of aconitia by Brandes, about 1821, to that of Geiger and Hesse, in 1832, and Von Planta, 1852, none give the percentage strength of aconite root, and hence I have no data to decide upon the normal percentage of the drug. The experiments were conducted with entire fairness, and as nearly parallel as is usual in such investigations.—*Proc. Amer. Pharm. Assoc.*, 1863.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture V.—*Thursday, January* 7, 1864.

Ladies and Gentlemen,—I have a few remarks yet to make to conclude the subject of dolomite, after which we shall proceed at once to the silicates.

There is one curious point with regard to dolomite, namely, that from a water containing carbonate of magnsia and carbonate of lime, held in solution by excess of carbonic acid, the carbonate of lime is precipitated as the excess escapes without being accompanied with any sensible amount of magnesia. This has been experimented upon by Bischoff and others: the Carlsbad waters, for example, which contain a notable amount of magnesia, let fall a deposit of carbonate of lime free, or almost free, from magnesia. On the other hand, if heat be applied to a solution of this sort, the deposit contains a sensible amount of magnesia. Thus, Mr. Sterry Hunt, to whom we are indebted for information on many points of importance in the application of chemistry to geology, found that an artificial water containing chlorides of calcium and magnesium, with bicarbonates of these bases, deposited by spontaneous evaporation a substance which contained $\frac{8}{10}$ths of carbonate of lime without any carbonate of magnesia. The same water, on the application of heat, let fall a deposit which contained 0·666 of carbonate of lime and 0·173 of carbonate of magnesia.

I have now laid before you a succinct account of the various theories which have been proposed to explain the mode of formation of dolomite. Two questions were especially proposed for consideration: the first is,—Has dolomite been deposited as such? The second is,—Has dolomite resulted from chemical action upon beds previously deposited—upon sedimentary beds? With regard to the first question, the only direct experiment in which dolomite appears to have been satisfactorily made, is that of Favre and Marignac, which consisted in heating carbonate of lime in a solution of chloride of magnesium in a closed glass tube, at 200° centigrade; but nothing like proof

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[†] The reader will observe that Prof. Mayer's test indicates twice as much aconitia as was obtained by experiment. I am unable to account for this, unless by inferring an error in Prof. Mayer's numbers.—W. P., Jr.

is advanced in favour, even of the probable occurrence of these conditions, and of this temperature in nature—at least, over a large area, and at the period of the formation of dolomite. As magnesia has a strong tendency to form double salts, many of which are very well known, and can be easily made, several methods would obviously suggest themselves to chemists as likely to produce dolomite of definite composition, but I believe all these have been tried and have hitherto been found unsuccessful.

The first question, then, so far as chemists are concerned, must be left unanswered for the present. It is a question which well deserves the attention of our chemists. With regard to the second question, whether dolomite has resulted from chemical action on sedimentary beds—of course I allude to carbonate of lime—it appears certain that in many cases it has been so produced. I need not recapitulate the evidence which has been advanced upon this point. That evidence rests upon geological observations; and although several chemical hypotheses have been put forth as to the *modus operandi*, yet they are unsupported by direct chemical proof. That limestone has in many instances been changed into dolomite there can be no doubt, nor can it be doubted that the change has been effected by the infiltration or percolation of water containing some magnesian salt or other. One of the most important and decisive observations, as it appears to me, leading to this conclusion, is that of Dana, concerning the comparatively large percentage of carbonate of magnesia in certain fossil corals. A clue is thus afforded to one method by which carbonate of lime may, in the course of time, become dolomite; and that is, by the action of the magnesian salts in sea-water at ordinary temperatures. Pseudomorphs of dolomite after calcspar, of which we have fine specimens in the museum above, furnish another strong argument in favour of the possibility of the transformation of carbonate of lime into dolomite in a similar manner. It is not, however, absolute proof, for it might be urged that the calcspar or carbonate of lime crystals had been first removed by aqueous action, leaving a mould which may have been subsequently filled with dolomite. Again, the more or less complete obliteration of fossils in certain limestone beds, which gradually pass into dolomite, is another argument in support of the partial replacement of carbonate of lime in limestone by an equivalent proportion of magnesia. This accumulation of arguments, I think, leaves no alternative but a positive answer to the second question. The hypothesis of magnesian vapour is, I venture to assert, purely on chemical grounds, one of the wildest and most unfounded ever suggested. Surely, before such a hypothesis was propounded, some reason should have existed for supposing that oxide of magnesium could be volatilised. There is, however, direct and positive experimental evidence that magnesia is perfectly fixed at the highest temperatures we can command in our furnaces and otherwise; and so far as we can judge from experiments as to the temperatures required to melt even the most refractory of the so-called igneous rocks, there is no ground for supposing that nature has employed, in the melting of these rocks, temperatures much greater than are necessary to effect their fusion. The mistake is often committed of confounding quantity of heat with intensity of heat. A pound of basalt requires for its fusion as high a temperature as a mountain of the same material, and we can melt basalt with much facility even in our common furnaces. But allowing that magnesia could be melted, as supposed, that would not explain the transformation of limestone into dolomite by the action of magnesian vapour; for in any case, the existence of this vapour necessarily involves the supposition of the exposure of carbonate of lime to an extraordinarily high temperature, and, consequently, the existence also of enormous pressure. However, admitting the concurrence of these conditions, how is the condensed magnesia to be converted into carbonate? There is not a shadow of chemical evidence in support of this extravagant and most unchemical hypothesis. That dolomite has been formed by the agency of liquids under very ordinary conditions, I have little doubt will be hereafter fully established by direct and indisputable chemical evidence.

We now proceed to the examination of the silicates—an extremely interesting and important class of bodies.

Silica, apparently so inert at ordinary temperatures, developes powerfully acid properties at high temperatures, readily displacing from combination even the strongest acids, such as sulphuric acid.

The silicates constitute a very large number of natural minerals which, variously intermixed or associated, compose our so-called igneous rocks. There are two classes of silicates—the anhydrous and the hydrated, or those which do not contain water and those which contain water. The anhydrous silicates are produced directly by igneous action, and the hydrated silicates are produced by aqueous or, as I may term it, thermo-aqueous action, or, if you please, hydro-thermic action, implying the operation of water at high temperatures under great pressure.

The silicates produced by igneous action may be directly formed by heating silica and the base together. We can make silicates without the least difficulty in this way. I have laid before you a numerous series of specimens so formed. Combination may take place without the least appearance or least evidence of fusion. That is an important point. Here is a silicate of oxide of cobalt, which is largely prepared for manufacturing purposes. It was made by mixing silica and oxide of cobalt together, and heating the mixture for a long time at a temperature very considerably below that which would suffice for the fusion of the silicate when formed. We have here other silicates so produced. When they leave the crucible they come out apparently as pulverulent as the mixture when first introduced. Here is a specimen—silica and lime heated together. It is perfectly pulverulent, and yet we know that combination has taken place, for if we apply an acid to it, the lime is removed, and the silica is separated, not in the form of sand or powder, but in the form of a jelly, which is a certain proof that the silica has been in a state of combination. There is some silicate of lime which has been treated with an acid, and you will observe there the flocculent silica which has been deposited. From this example we see that combination may take place without any sign of fusion, and this affords an example of the fallacy of the old adage about bodies not acting except when dissolved,—"*Corpora non agunt nisi soluta.*" This principle of forming silicates by exposing them to a temperature insufficient to cause fusion, is much resorted to in manufacturing operations, as, for example, in the production of certain kinds of glass. It is called "fritting." Supposing we have a silicate consisting of a very fusible base—oxide of lead, for example,—if we heat a mixture of the components to a high temperature, the oxide of lead will melt and subside, and the surface of contact between the lead and the silica being greatly diminished, the lead will be protected to a great extent from the action of the silica. But if, on the other hand, fritting be resorted to, that is, if we keep the two bodies at a lower temperature than is required to fuse them, extensive contact is preserved, and we then succeed much better in producing such a silicate. The amount of contact is much greater than it would be if the oxide of lead were allowed to fuse and subside to the bottom of the vessel. After combination has been effected by means of fritting, the temperature may be raised in order to melt the product.

We come now to the consideration of the physical properties of the silicates. The most familiar examples of silicates are presented to us in the form of glass, of which there are several varieties; for instance, crown or common window glass, bottle-glass, and flint-glass—glass which contains a large amount of oxide of lead.

We may divide the silicates into two distinct classes

There are, first, the amorphous, or formless silicates; and these, again, we divide into two classes or divisions—firstly, the vitreous or glass-like silicates; and, secondly, those which are opaque and stone-like, and are not vitreous in their aspect. The second class of silicates includes those which are crystallised.

As I said just now, the various kinds of common glass are familiar examples of the vitreous silicates. Crown-glass and bottle-glass are silicates of soda and lime. Flint-glass, on the contrary, is a silicate of potash and oxide of lead. We have here very beautiful specimens of zinc glass, oxide of zinc in this description of glass replacing oxide of lead. In nature we find a beautiful kind of glass—obsidian. It is a black glass, which, in thin slices, is translucent, and does not exhibit much colour. The colours of the glass which we produce in commerce are due to the presence of metallic oxides in small quantity. There is red glass, the colour of which is due to dioxide of copper. A yellow glass has been manufactured of late, the colour of which is imparted by oxide of uranium. Blue is due to oxide of cobalt; purple, to oxide of manganese; and black, to mixtures of various oxides, especially iron and manganese. There is one point in connection with black glass to which I must call attention. We have a specimen in the museum, which came out of the Exhibition of 1851, from the French department. It is an intensely black glass. M. Dumas assured me that the black colour was communicated entirely by sulphur. In iron furnaces there are slags which are intensely black, and there are reasons for supposing that sulphur in certain combinations—probably as a sulphide—may communicate the black colour to them.

The next point to which I shall refer is one of considerable interest, and especially, I think, to geologists. It is the subject of devitrification, or the crystallisation of glass. If we take a piece of ordinary glass—common bottle glass, for example—and expose it for a long time to a red heat—we will say a temperature quite insufficient to melt it—it will become perfectly opaque. If we continue the heat long enough, it will cease to present the slightest appearance of vitreous character, and will be converted into a stone-like mass. In other words, it will become crystallised, or devitrified. Again, if we melt glass, and allow it to cool very slowly, the same phenomenon occurs. I have here a very extensive series of specimens, which I have collected from time to time, illustrating all these points, and they are well worthy of your examination. There is a piece of common crown glass. When that is heated and slowly cooled, you will find that beautiful little radiated crystals will start up through the mass in all directions. These will gradually enlarge, forming globular masses, which at length will become so considerable as to occupy the whole mass. It is very beautiful to watch the changes that take place in glass of this kind. There is another specimen in which you will see a number of globular white masses, each being a series of radiating white crystals. Here again is a larger specimen. It is very curious, in the case of bottle glass, to see the change of colour consequent on the crystallisation. Here is a piece of ordinary bottle glass which has become opaque and acquired this blue coloration simply by being heated in the manner described. This reddish brown portion is the crystallised portion of it. It consists of large nodular masses formed of radiating crystals. Then again we find that these crystals are arranged in rows or definite layers, reminding one very forcibly of a certain kind of obsidian—Lipari obsidian. These specimens are nothing more than pieces of ordinary glass converted into a crystalline form in the manner I have described. If I were to take this piece and expose it to a high temperature, and cool it rapidly, I should get glass again just in the same state as it was before. If we take igneous rocks, pound them, melt them down, and cool them slowly, we get a mass like that—opaque and crystalline; but if, instead of cooling the melted rock slowly, we cause it to cool rapidly, we get a mass of a vitreous character. We frequently find in the slags of our furnaces that one portion of them is vitreous and the other portion crystalline. Other things being equal, that part which cools most rapidly will always acquire a more vitreous character than the other part. Hence it is, that on the outside of these pieces of slag you find a glassy appearance. Here is a very beautiful specimen of crown glass, in which you will see crystals of large size. I may direct your attention to the case in the museum above, which contains numerous illustrations of devitrified glass. Here is another beautiful specimen—the only one of the sort I ever saw. I had it from Mr. Bontemps some years ago. It is flint glass—silicate of potash and lead—and is in beautiful crystals.

In this process of devitrification, there may be a simple rearrangement of particles in a crystalline form. We may, for example, have a definite chemical silicate; that silicate, if cooled rapidly, may be a glass, or, if cooled slowly, it may be a mass of crystals. On the other hand, we may have a mixture of silicates; and, on cooling, one of these shall crystallise out, producing a more or less definite crystallised silicate, and there shall remain a portion non-crystalline—a sort of "mother-water" of glass, if I may apply that chemical phrase to this subject; and thus, when we come to examine the non-crystalline portion in certain cases, and compare the constitution of that with the crystallised portion, we find a difference. This is exactly what takes place in ordinary solutions. There is no reason why the same thing should not occur—as it does occur—in the case of glass. The question has been examined by Terreil. An attempt has been made to employ our basalt, occurring in South Staffordshire, along the line of the Rowley Hills, on a large scale, for manufacturing purposes. The Messrs. Chance took out a patent, some years ago, for this application of basalt. It was proposed to melt it, cast it, and then cool it; and I have seen some articles so produced—such as the lintels of doors, and so forth; but, owing to some difficulties which arose, the process was ultimately abandoned.

Let me now direct your attention to certain accidental forms of silicates. I think there are some points in connection with this part of the subject which may interest geologists especially. Silicates are largely produced in our iron-smelting furnaces, and sometimes you will find, in looking over the cinder heaps, that these silicates are present in a variety of peculiar forms. Here is a specimen I got from Staffordshire some years ago. It is remarkably cellular, resembling honeycomb; and the cellular structure exists throughout a large mass in this instance. It could only be formed, I think, by the elimination of some gaseous matter from every part of the slag during solidification. Then there is another form in which the slag is found—that of hair-like threads. This is some from South Wales. It is a delicate, wool-like substance. I have also some from Prussia. It is a slag of by no means uncommon occurrence. It is nothing more than delicately spun glass—filaments of glass which have been spun by the operation of the blast. The blast has, in some way, caught the slag, and spun it into delicately hair-like threads. On examination, you will find little globules of glass occurring here and there among the threads. I mention this form particularly, because nature presents us with similar products—in fact, so similar, in all respects, that if you place the two together you will hardly be able to distinguish them. I believe we have in the museum above some volcanic specimens of this sort. I will give you a statement of Dana on the subject of this capillary volcanic glass, which he observed at Kilauea, in the Pacific Ocean. "At one of the pools, the formation of Pelé's hair, or capillary volcanic glass, was in progress. It covered thickly the surface to leeward, and lay like mown grass, its threads being parallel, and pointing away from the pool. On watching the operation for a moment, it was apparent that it proceeded from the jets of liquid lava thrown up by the process of boiling. The currents of air blowing across these jets bore off small points, and drew out a glassy fibre, such as is produced in the common mode of working glass. The delicate fibre floated on till the heavier end brought it down, and then the wind carried over the lighter capillary extremity. Each fibre was usually ballasted with the small knob which was borne off from the lava-jet by the winds."

If you will take the trouble to examine this specimen, and compare it with the specimen above, I think you will see that the two are so nearly identical in all essential respects that they might easily be confounded with each other.

We now come to the subject of the fusibility of silicates. What is required to effect fusion in many cases is not so much an extremely high temperature as long-continued heat. There are some which do, of course, require very high temperatures, and which resist even the highest temperatures we can command in our furnaces.

The silicates are sometimes excessively liquid when fused; at other times they are more or less viscous; and this is especially the case with the slags or cinders from our blast-furnaces. If you examine the operation of these furnaces, you will detect a little delicate lava stream. There may be no outward sign of such a stream, the whole being covered with solid slag, but upon pushing a walking-stick through the upper portion you will render visible a little current of molten slag beneath. In these slags when melted you will occasionally find a considerable quantity of unfused and suspended matter mechanically present. In a slag obtained from our copper furnaces, called "ore furnace slag," you will always find a quantity of quartz diffused through the mass. Here is a sample. The quartz forms no part of the constitution of this slag, but is there simply mechanically. The presence of such matter can easily be accounted for in natural lava. A lava stream may in its course come in contact with foreign matters, take them up, and transport them to a distance, and on that account I present this specimen before you as an illustration of what occurs in nature.

Now, with regard to the composition of silicates. We may have simple silicates, perfectly definite in atomic constitution, consisting of one single base, and silica. Of these there are two distinct classes. There is that represented by the RO base, as chemists term it. That is the base which is typified, we will say, by lime, or magnesia, or protoxide of iron, or protoxide of manganese. And then we have the other kind of base, which is represented thus—R_2O_3, and which is illustrated by alumina, for example. We might have a silicate of lime. That would be a simple silicate—a silicate consisting of one equivalent of base and one of silica. The same remark applies with regard to the other kind of base. We have definite silicates containing each of the two types of bases. Thus, our common iron furnace slag, of which you have numerous specimens before you, consists of silicate of lime and silicate of alumina. Here is one which is a definite chemical compound—silicate of lime and alumina. It contains, however, a small quantity of foreign matter mechanically present. Then we have mixtures—and this is a point of importance—of definite silicates with each other,—not *compounds*, but simple *mixtures*; and these occur abundantly in nature. Lastly, we have definite silicates or mixtures containing foreign matter. The ore furnace slag which I exhibited to you just now is an example. This foreign matter may either be perceptible to the eye, as in the case of that slag; or it may be minutely diffused through the mass, and invisible, as it is in the case of this slag.

We will examine various definite silicates occurring in nature—silicates known to occur in nature, but which have been produced artificially.

The first of these is wollastonite, or tabular spar, which crystallises in the oblique system. This wollastonite is a compound essentially of lime and silica, and the oxygen of the silica is exactly double that of the lime; so that, taking the old method of notation with respect to silica, the chemical formula will be $3CaO,2SiO_3$—three equivalents of lime, and two of silica. That gives three equivalents of oxygen with the lime, and six with the silica. Wollastonite may be formed by strongly heating lime and silica together in certain proportion. Here is a specimen of the natural wollastonite from America; and here is a specimen of the artificial mineral prepared here some years ago. These specimens require to be looked into carefully with a magnifying-glass. There are cavities here which are filled with this wollastonite. Here is another specimen, on the surface of which you will see very distinct evidence of crystallisation. There is no doubt whatever about our being able to form this substance by the direct union of the constituents. I have obtained it occasionally pretty well crystallised. Daubrée informs us that he has produced wollastonite by the action of water at a high temperature on glass. The temperature was 400° centigrade, requiring, of course, a correspondingly great pressure. The alkaline silicate dissolves, and an opaque residue of the glass is left. This residue is not amorphous, but consists, according to Daubrée, of very fine, acicular crystals. After separating, by levigation, the associated minute crystals of quartz formed at the same time, he analysed the residue, and found it to contain

Silica	53	per cent.
Lime	46	,,
	99	,,

There were also traces of magnesia. According to the formula I have given, the calculated composition of the natural mineral is—

Silica	52·38	per cent.
Lime	47·62	,,
	100·00	,,

On comparing these two analyses, notwithstanding the slight difference between them, there is no doubt about the identity in composition of these two bodies. We have, then, facts to show that wollastonite may be formed directly by igneous action, without the aid of water; and we have the facts alleged by Daubrée to show that it may be formed by the action of water at a high temperature on silicate of lime and soda, that being the composition of glass. According to Bischoff, wollastonite is very easily decomposed by water containing carbonic acid, with the formation of carbonate of lime, and the separation of silica. In some analyses of the native mineral, we find a little carbonic acid and water put down, though in small quantity. Wollastonite in nature accompanies garnet, fluor, and native silver, in limestone, at Pargas, in Finland, and at Kongsberg, in Norway. It occurs in basalt, along with prehnite, at the Castle Rock, Edinburgh; at Ceylon, with garnet in gneiss; at Auerbach, in crystallised limestone and gneiss with garnet, epidote, magnetic pyrites, and iron pyrites (FeS_2). The iron pyrites is in a finely divided state, but in such proportion as to render useless the rock, which would otherwise be valuable as a marble. Wollastonite is also present in matter ejected from Vesuvius at Fossa Grande, and in lava at Capo di Bove, near Rome; at the side of a vein of garnet and gneiss in New York County; and it is found with garnet and felspar, and garnet and quartz.

The next mineral which I shall describe to you is chrysolite, or peridot. This is a silicate of magnesia, in which the oxygen of the silica is exactly equal to that of the magnesia. The formula is $3MgO,SiO_3$—three equivalents of magnesia and one of silica. These bodies can be combined directly by exposing the mixture to a high temperature, but the product has not been obtained well crystallised by that means. The result has been, an imperfectly-fused, white, hard, porous mass. However, by the addition of boracic acid, Ebelmen succeeded in producing very good specimens of chrysolite. There is some chrysolite produced by Ebelmen himself. He mixed magnesia with silica in proper proportions, and added boracic acid, which simply played the part of a solvent at a high temperature. The mixture was exposed to a great heat in a porcelain furnace, and the boracic acid evaporated, leaving chrysolite in a crystalline form.

Iron chrysolite, or chrysolite in which the magnesia is partly or wholly replaced by oxide of iron, is a frequent constituent in our furnace slags, and occasionally we obtain magnificent specimens of it. Here is a specimen most beautifully crystallised. Iron chrysolite varies very much in composition, the magnesia being replaced more or less by oxide of iron. In nature we find some of these varieties very rich in protoxide of iron. Here is a specimen in which magnesia is, practically, wholly replaced by protoxide of iron. It has, however, the crystalline form of chrysolite, and has the same formula precisely. We can produce it, and have produced it, by heating together silica and protoxide of iron, or a certain compound capable of yielding protoxide of iron at a high temperature. There is no difficulty in obtaining it well crystallised on a small scale. It crystallises in the prismatic system. This mineral occurs in lavas, in basalt, in obsidian, and in greenstone. It is present also in meteoric iron, being found, for example, in Pallas's famous meteorite, and in the well-known meteorite from Atacama, in Peru. But how to explain this fact is, I confess, a puzzle to my mind. How it comes to be so uniformly diffused through such masses of crystalline iron—for it is always well crystallised—it is difficult to explain at present. Iron chrysolite frequently contains oxide of nickel in small quantity.

When exposed to a bright red heat for some time, iron chrysolite takes up a certain amount of oxygen. In fact, by continuing the heat, you can at length convert the protoxide of iron into peroxide of iron. I can show you crystals which have been treated in that way. Here are some. In fact, these crystals are pseudomorphs.

I shall now direct your attention to the mineral augite, or pyroxene—a well-known mineral, crystallising in the oblique system. The relation between the oxygen of the silica and that of the bases in pyroxene is exactly the same as in wollastonite; but, instead of the base consisting only of lime, as in that mineral, the lime is replaced by variable proportions of magnesia, protoxide of iron, and protoxide of manganese. Alumina is also frequently present. If you were to collect all the analyses which have been made of augite, you would find them very variable; yet they all may be referred to this simple formula, $3RO,2SiO_3$, or RO,SiO_2. The two minerals, augite and wollastonite, are not chemically distinct. We have a light-coloured variety of augite containing chiefly lime and magnesia; and we have a dark-coloured augite, containing much protoxide of iron. This mineral is produced in the slags of furnaces. Here is a specimen which I obtained many years ago from the Olsberg furnaces on the Rhine. These crystals have been examined by Professor Miller, of Cambridge; but they were not sufficiently distinct to give him definite information as to their system. They, however, evidently resemble crystals of pyroxene. They have the same formula, and contain—

Silica	53·37
Alumina	5·12
Lime	30·71
Magnesia	9·5
Peroxide of manganese	1·41
Peroxide of iron	0·95
	101·06

There is no doubt about the identity of this with certain forms of minerals occurring in nature. This is a remarkably well crystallised specimen of pyroxene from slag. I have never seen a better. We have proof positive that this mineral can be formed, and beautifully crystallised, by heating directly together the constituents—lime and silica. Daubrée tells us that he has made it by the action of the concentrated mineral water of Plombières on glass. The variety obtained by him resembled the mineral diopside which occurs in nature. Pyroxene occurs in volcanic and certain crystalline rocks. It is associated with garnet and talc in veins traversing serpentine; and it occurs in limestone and certain dolomites.

The next mineral we come to is amphibole or hornblende. The system of crystallisation is the same as that of augite; the angles, however, differ. The composition may be the same, but it is equally variable. The two minerals differ, essentially, then, in crystalline system, and nothing more. By fusion, amphibole or hornblende may be converted into augite. This has been proved by the experiments of Berthier, Mitscherlich, Gustave Rose, and Rammelsberg. The varieties of this mineral occurring in nature are very numerous. Among them may be mentioned tremolite, actinolite, asbestos, and pargasite. Amphibole occurs as a chief constituent in the rock called syenite. Light varieties occur in granular limestone, dolomites, granite, and in the marble of Glen Tilt.

Garnet is the next mineral to which we shall direct attention. It crystallises in the cubical system. We have many well known and beautiful forms of garnet. It is very often an ornament of our mineralogical cabinets.

I shall direct your attention especially to the formula of garnet, because it bears a striking relation to the formula belonging to a substance continually produced in our furnaces, and also occurring in nature. The formula of garnet is—$3RO,SiO_3+R_2O_3,SiO_3$ or $3RO,2SiO_2+R_2O_3,SiO_2$. It consists of three equivalents of a base of the RO type, represented by lime, but one equivalent of the lime may be replaced by other isomorphous bodies, such as protoxide of iron, or protoxide of manganese. If you calculate the oxygen of the silica, you will find it exactly equal to the oxygen of the base; and the oxygen in the one series of bases bears the same relation to that of the silica as the oxygen in the other.

Many attempts have been made to produce garnet directly, but none have succeeded well, no good crystals having been obtained. However, some time ago a mineral collector came to me with some specimens from the Monkland iron furnaces in Scotland. Being always very curious in looking after these matters, I perceived immediately something like garnet among the specimens. Here are some of the crystals. They are so small that it would be perfectly useless to attempt to analyse them. They have the precise crystalline form of garnet. They have been very carefully examined by Professor Miller, of Cambridge, and they have been found to be crystallographically similar to garnet. These are probably the best crystalline specimens of artificial garnet ever found. M. Studer is reported to have made garnet directly by fusing together its constituents.

The next mineral with which we shall deal is humboldtilite or mellilite. It is one which has been produced artificially on a large scale. It is constantly produced in our blast-furnaces. It is essentially a silicate of lime and a silicate of alumina, the lime being replaced more or less by magnesia, protoxide of iron, or protoxide of manganese. We have only to double the silicate of lime in the last formula, and we get the formula of humboldtilite—

$$2(3CaO,SiO_3)+Al_2O_3,SiO_3.$$

The oxygen of the silica of this mineral is exactly equal to the oxygen of the bases; but the oxygen of the lime series is exactly double that of the alumina series. The native mineral occurs crystallised only in small crystals.

Here we beat nature hollow. I place before you specimens of humboldtilite which are identical in composition with the natural mineral, but the crystals are four or five times as large as any found in nature. I have been for many years looking after these specimens, but I have never found any equal to some which I obtained many years ago in South Staffordshire. The form of the crystal is a square prism. We find it beautifully crystallised in our slags, but generally without any modifications. Here you have modifications, the angles being replaced by planes. The crystals are translucent, and possess considerable lustre. This mineral occurs in the lava of Vesuvius, and at Capo di Bove, with nepheline. As I said just now, we beat nature hollow in the size of the crystals of this particular mineral, though, I must say, she has the advantage with regard to a great many other productions.

The next mineral to consider is gehlenite. We have found this mineral produced artificially once, and once only. I was fortunate enough some years ago to procure one specimen, but only one. None have been obtained since. Here it is. It is not very much like the natural mineral externally, but it is still identical with it in formula. I analysed this artificial mineral some years ago, and Professor Miller, of Cambridge, has carefully examined its crystallographical and physical properties. We suggested a new formula for it; and, at the same time, Rammelsberg, from experiments he was making with the natural mineral, actually suggested our identical formula. The formula is this—$3(3CaO,SiO_3)+3Al_2O_3,SiO_3$. You will now see its relation to the formula of humboldtilite. Gehlenite occurs in the Fassa Thal, in Tyrol, and in crystals embedded in calcspar in syenite. All these crystals before you contain impurities which in no way enter into the composition of the mineral.

We next come to felspar, or orthoclase, or potash felspar. Felspar has the formula $KO,SiO_3+Al_2O_3,3SiO_3$. It is essentially silicate of potash and silicate of alumina, and exactly resembles in constitution, or, at all events, is equivalent in constitution to common alum, if you replace the sulphuric acid by silica. It is a silicate of potash, in which the oxygen of the silica is three times as much as that of the potash, and that of the silica with the alumina three times as much as that of the potash. It was found, in 1834, in the Sangerhausen copper furnaces, near Mansfeld. When they were breaking up some of the old furnaces, beautiful crystals of artificial felspar were found. They occurred in small cavities in the lower part of the furnace, and some of the specimens had a beautiful amethystine tint. They have been found since at other places, but I believe they are excessively rare. Fortunately, I am able to place before you specimens of the artificial felspar obtained from the Sangerhausen furnaces. Here is one composed of crystals of considerable size—true crystals of felspar, which have been carefully examined by competent observers and analysed. We have four or five analyses, all of which are perfectly concordant, and agree with that of natural felspar. These specimens are very small, but at the same time the crystals are comparatively large.

We have, then, a proof of the formation of felspar by furnace operations, but I am not aware that any clue has been given to the precise *modus operandi.* Daubrée tells us that he has produced glassy felspar, or rhyacolite, by exposing obsidian to water at a high temperature; it was changed into a greyish matter, having still the same chemical characters, but by the naked eye it was seen to be crystalline, like a fine grained trachyte. The powder of the substance thus produced, when examined by the microscope, showed clearly the characters of crystallised felspar. He also obtained it by heating kaolin in a glass tube with the water of Plombières at a high temperature. If these statements are accurate we have proof of the formation of felspar by hydro-thermic action.

PHARMACEUTICAL MEETING.

Wednesday, February 3, 1864.

Mr. Sandford, *President, in the Chair.*

(*Continued from page* 80.)

Mr. Sanger read a paper "*On the Process of Percolation as Applied to Tinctures.*" After some general remarks on the process of percolation, the author referred to the directions for making tinctures given in the British Pharmacopœia. These, he said, looked like a compromise between the directions of the Edinburgh and London Colleges. The method now ordered was half maceration and half percolation. The directions for any tincture will serve for an illustration. We quote the first:—"Tinctura Aconiti. Take of aconite root, in fine powder, two ounces and a-half; rectified spirit, one pint. Macerate the aconite root for forty-eight hours, in fifteen ounces of the spirit, in a close vessel, agitating occasionally; then transfer to a percolator, and, when the fluid ceases to pass, pour into the percolator the remaining five ounces of the spirit. As soon as the percolation is completed, subject the contents of the percolator to pressure, filter the products, mix the liquids, and add sufficient rectified spirit to make up one pint." This process the author considered a good one. For details on the subject of percolation he referred the meeting to his prize essay, and now only expressed his opinion that by this method tinctures were obtained of a brighter and more natural colour, and of a more uniform strength, than by macerations as ordinarily used by druggists. The tincture was prepared in a short time; there was no necessity for the continued agitation so often forgotten in the hurry of business, and there was no temptation to make use of some of the preparation before the prescribed period of maceration had expired. He then proceeded to describe a percolator of his invention, which was exhibited to the meeting. [It consisted of a funnel without a stem, supported within a jar to receive the fluid percolated; the whole shut in by a cover, which could be rendered air-tight.] In carrying out the process of percolation, the packing of the ingredients was the most important thing to attend to. They should at first be moistened with a little of the menstruum to lay the dust, and might, in many cases, be advantageously divided by well-washed silver sand, a layer of which should be placed at the top. Three degrees of tightness may be observed in the packing—ginger and bark, for example, should be tightly packed, rhubarb moderately tight, and hops but loosely packed, or only pressed down on the surface. To illustrate the advantage of the process of percolation, the author stated that he had prepared three specimens of Tinct. Card. Co. by maceration, all of which differed in colour, while all he had made by percolation were alike in shade.

In the course of the discussion, Professor Redwood said he had no doubt Mr. Sanger's percolator was a useful instrument; but, for general use, he thought that made by the York Glass Company preferable. He thought placing the funnel within the jar was a waste of room, and made the instrument inconveniently bulky.

A short conversation followed, in the course of which a member said that he had found nothing answer the purpose of a percolator so well as a cylindrical pipe; and another stated that he considered the process of percolation an excellent one for making tinctures; but he preferred to carry it out himself in his own way.

BRISTOL NATURALISTS' SOCIETY.

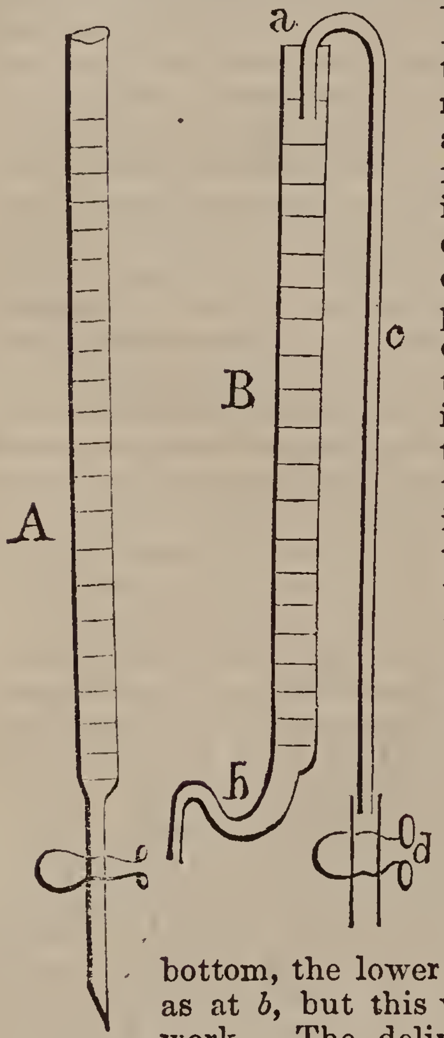
Thursday, February 4, 1864.

W. Sanders, *F.G.S., President, in the Chair.*

The purchase of an Apteryx, the rare, wingless bird of New Zealand, was sanctioned for presentation to the museum of the Bristol Institution.

Mr. Charles Moore, of Bath, detailed the results of his examination of some beds at Patchway, five miles from Bristol, laid open by the cuttings of the South Wales Union Railway. The Rhaetic beds, part of the English series corresponding to the Keuper sandstone of Germany, were recognised, and in close proximity to them a bed at first supposed to be white lias, but which, on examination, yielded Chonetes Hardrensis, and, what was more remarkable, several species of Chonodonts, hitherto only known in the Ludlow bone bed. Several Permian fossils occurred, but, on the whole, the author considered these beds to belong to the upper carboniferous limestone. It was suggested during the discussion of this paper, that this extraordinary assemblage of organic remains of different geological epochs might be due to the denudation of older beds.

Mr. **Edward Collens**, Assistant in the Bristol Trade and Mining School Laboratory, then read a paper "*On Some Improvements in Dr. Mohr's Burette.*" After adverting to the rapid increase in volumetric methods of analysis, and describing the ordinary form of Mohr's burette, A, in which the test solution came in contact with caoutchouc tubing, which, with permanganate of potash especially, was often injurious, the author stated that the idea had occurred to him that the pinch-cock might be made to regulate the ingress of air into the burette, instead of the egress of liquid, and he therefore contrived the arrangement sketched in B. At *a* is a tight-fitting cork, with glass tube, *c*, bent over parallel to the burette, terminating in a piece of India-rubber tubing and pinch-cock, *d*, which was thus brought close to its usual position. To avoid the entrance of minute air-bubbles at the bottom, the lower end of the burette was bent as at *b*, but this was not necessary for rough work. The delivery of the test liquid was quite as easily regulated as in the usual form, and it was not brought in contact with anything but glass. The junction at *a* might be advantageously made by fusion, in which case the instrument was filled by dipping the end, *b*, in the test liquid, and applying suction through the tube, *c*. The minor advantages of this modification were, immunity from dust and contact of air, thus preventing loss by evaporation, absorption of carbonic acid, &c.; and the author stated that, with a tight joint at *a*, the level of the liquid in the instrument had remained constant for many days.



A **Member** then exhibited a very large crystal of quartz, which gave rise to some discussion on its mode of formation, striæ, and other points of interest.

ACADEMY OF SCIENCES.

Monday, February 8, 1864.

The only chemical paper read at the last meeting of the Academy was "*On the Oxidation of Wine*," by M. Berthelot. It contained nothing of general interest, being simply an account of experiments undertaken to refute M. Maumené and others.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(twelfth notice.)

(Continued from page 82.)

The notices of safflower and murexide lead directly to a consideration of the colours from aniline and its homologues, which have almost entirely supplanted them, and we may dismiss the former very briefly. Safflower, indeed, is now almost a subject for history, since it is at present only employed to dye silk of a peculiar cherry-red colour, which cannot yet be obtained from the aniline colours, but is in small demand.

Murexide deserves a more extended notice, from its interesting chemical history, but a very short account must suffice. This curious substance was first noticed by Prout, but was procured in a state of purity and analysed by Liebig and Wöhler. The author of this report, who was at the time a pupil in Liebig's laboratory, mentions, with becoming pride, the triumph he shared when a few grammes of murexide were first obtained in a state of purity.

Murexide, as all our readers know, is obtained from uric acid, which latter, for this purpose, is procured from Peruvian guano. The method by which uric acid is obtained from guano is very simple, and we are almost tempted to make a digression here on the subject of chemical patents—since a process for the purpose was patented by Mr. Brooman in 1856. It was, of course, a "communication," and it is not difficult to guess from whom. The process, as we have said, was of the simplest nature: it consisted in treating the guano with hydrochloric acid, which dissolves the carbonates, oxalates, and phosphates of ammonia, lime, and magnesia, and leaves the uric acid with some earthy and organic impurities. This residue can be employed in the manufacture of murexide, but pure uric acid can be obtained by dissolving it out with potash, and precipitating the solution with a mineral acid.

The transformation of uric acid into murexide is also effected in a very simple manner. Uric acid is first dissolved in cold nitric acid, to which it is added in small quantities at a time. In this way a dark brown liquid is obtained, which consists "chiefly of nitrate of urea, alloxan, and alloxantine. These two last substances frequently form a crystalline crust on the surface of the liquid, and their simultaneous presence forms one of the most favourable conditions for the abundant formation of murexide." To this dark brown liquid carbonate of ammonium is added, and the solution carefully evaporated at a low temperature. "It is better, however," says the reporter, "to add ammonia or its carbonate in small quantities at a time to the nitric solution, till the liquid is neutral or slightly alkaline, which reaction it should permanently maintain. This liquid is then heated to 60°—77° C., and yields, on cooling, crystals of murexide. The mother liquid is again heated with a small quantity of ammonia, and cooled, when a fresh crop of crystals of murexide are obtained."

We may quote here, as a fact for history, that Mr. Rumsey, of Manchester, once turned out 12 cwt. of murexide weekly, to produce which he consumed 12 tons of guano. But murexide now can be obtained from another source. The researches of Kopp and Hlasiwicz have shown that, by the reaction of cyanide of potassium upon picric acid, a body is produced identical in every respect with the murexide obtained from uric acid. "To a hot saturated solution of the cyanide is added a solution of picric acid (one part dissolved in seven or eight parts of boiling water), and the solution is allowed to boil for some time. On cooling it deposits a crystalline mass, consisting chiefly of impure purpurate of potassium. By filtering and squeezing through linen, redissolving the crystalline mass in hot water, and adding carbonate of potash to the filtrate, the salt is reprecipitated; purpurate of potassium is thus obtained, this salt being but slightly soluble in the alkaline liquid. This precipitate is filtered off, pressed, and redissolved in hot water; sal ammoniac is then added, and, on cooling, beautiful crystals of murexide are obtained."

The methods of applying murexide to dyeing and printing are numerous and somewhat complicated. To dye purple, a mordant of corrosive sublimate is usually employed. The solution of murexide is added to a bath of sublimate, and the mixture is made acid with nitric acid. The silk is agitated in this bath (cold) until the desired shade is produced. Subsequent immersion in a bath of sublimate containing three per cent. of the salt gives freshness and brilliancy to the colour. To dye silk yellow, a salt of zinc is substituted for the salt of mercury, and the fabric is afterwards passed through water made slightly alkaline with carbonate of sodium. Wool is sometimes first mordanted with corrosive sublimate, and then passed through the murexide bath; or the process may be reversed. Sometimes nitrate of lead is added to the murexide bath, to facilitate the fixing of the colouring matter.

Rose colour and purple tints are obtained on cotton by nitrate of lead and murexide dissolved together in water. The cloth is first hung in a damp room pervaded by a slightly ammoniacal atmosphere, and then passed through a weak sublimate bath.

The murexide colours are very beautiful, and have the advantage of being permanent in light. The objection to them is, that they are excessively sensitive to the action of sulphurous acid, which tarnishes and discolours them with extreme rapidity. The air of all towns in which gas is burned is, therefore, inimical to them, and they have been almost entirely replaced by the aniline colours, to which we shall confine our next notice.

A System of Instruction in Qualitative Chemical Analysis. By Dr. C. Remigius Fresenius. Edited by J. Lloyd Bullock, F.C.S. Sixth Edition. 1864. London: J. Churchill and Sons.

It is a task of no inconsiderable pleasure to watch the steady growth and gradual improvement manifested in each succeeding edition of a standard work. The text-book before us is that which has had a large share—indeed, has taken the principal duty, in instructing the English student in chemical analysis. The system is that known to have been followed with great success in the Giessen laboratory and other schools of science in Germany and throughout the continent of Europe; and when a demand arose in this country some twenty years since for a text-book of chemical analysis, it was the English translation of Dr. Fresenius' work which first supplied the deficiency. A little later appeared the smaller treatise of Professor Will; but as the character of this work was indicated in the title, the "Outlines of Qualitative Analysis" could not be supposed to embrace the whole subject, and it omitted consequently many valuable details relating to the preparation of the chemical reagents, and their tests of purity, which were fully described by Fresenius. On comparing the present volume of 350 pages with former editions, it is at once manifest that the new system of spectrum-analysis is that subject which has mainly contributed in augmenting the size of the treatise before us. A noteworthy addition is the beautifully coloured frontispiece, indicative of the more characteristic spectra among the metallic elements. It is to be regretted that the position of the single green ray of thallium is not pointed out in the spectrum chart; but, as if in some measure to compensate for this omission, there is a remarkably well-written chapter descriptive of the leading chemical reactions of this element to be found at page 111. The detection of the rarer metals, *e.g.*, cæsium, rubidium, thorium, yttrium, cerium, lanthanium, didymium, and even erbium and terbium, are referred to under their respective analytical groups, and these particulars are printed in small type to denote their minor importance, or, rather, less frequent occurrence.

The metal "wolframium" and earth "berylla," are terms not commonly employed in the English language, but there is some foundation for their use in the fact that the symbols W and Be have always been taken as representing the metals tungsten and glucinum. We have not, however, yet gone so far as to adopt the German *kalium* and *natrium*.

Amongst the many novelties introduced into the present edition may be mentioned the use of the dialyser of Professor Graham; the full description and woodcut illustration of Kirchhoff and Bunsen's spectrum apparatus; the special instructions for the recognition of the vegeto-alkaloids; a systematic course to be adopted in the detection of poisons, including the search for unoxidised phosphorus; the several methods available for the isolation of strychnine, hydrocyanic acid, arsenic, &c., in the event of these substances being present in admixture with complex organic matters. In fact, as a treatise on Toxicology, Fresenius' Analysis can be strongly recommended; and in this connexion the numerous illustrations of apparatus employed in the detection of arsenic, phosphorus, and other poisons cannot fail to be highly suggestive to the analyst engaged in medico-legal inquiries.

The system of analysis adopted in the examination of soils, ashes of plants, and mineral waters remains substantially unaltered. There are several points in this direction which are, we think, yet open to considerable improvement. For instance, in the preparation of vegetable ashes for the purpose of identifying or determining the mineral constituents of the plant, it is not well to carry on the incineration until all the carbon is burnt off; but a more judicious course would be in all cases to rest satisfied with the complete charring of the organic structure, then to extract with water in order to remove the soluble alkaline salts, which are so readily volatilised if the incineration be pushed to the utmost limit, and then finally to dry and burn the carbonaceous residue for the purpose of recovering the remainder of the mineral salts. Another point open to criticism is the continued reference to "crenic and apocrenic acids" as constituents of natural waters. It is much to be regretted that the identification of dissolved organic matters and the determination of their amount by quantitative analysis are still notoriously unsatisfactory, and the day has yet to come when these heterogeneous matters shall be described and regarded in a clearer and more definite light.

The book before us is remarkably well printed, and free from errata. We have noticed but one or two trifling misprints; thus, at page 238, line 17, "on" should have been "no," and the type has slipped a little on page 246. The mode of division into chapters and paragraphs distinctly numbered facilitates reference; and there is much satisfaction in being informed of the authority upon which a statement is made, and the name has been generally given between parentheses. A very useful table of weights and measures concludes the volume. The kilogramme is here stated, we believe correctly, to be equal to 15,432 grains; whereas the English translation of "Liebig and Kopp's Annual Report" makes the same unit equal to 15,434 grains. There are some repetitions to be noticed in the analytical details prescribed for the examination of simple and of complex substances; but these are only such as could not be entirely avoided in a work devoted to the purposes of instruction. Altogether, we feel strongly disposed to recommend the work before us to the favourable notice of the student in chemical analysis; and must remark, in conclusion, that the sixth edition fully maintains the high character of a standard work which "Fresenius' Analysis" has so long enjoyed.

Researches on the Solar Spectra of the Chemical Elements. By G. Kirchhoff. Translated by H. E. Roscoe, B.A., Ph.D., F.R.S., &c. Part II. London: Macmillan and Co. 1864.

This second part of Kirchhoff's interesting and important work contains the latest observations of the author on the spectra of the metals potassium, rubidium, lithium, cerium, lanthanum, didymium, platinum, palladium, and an alloy of iridium and ruthenium. Beautifully executed diagrams are appended, in which the lines are laid down with the minutest accuracy. For instance, between the double line D, one nickel, one zinc, and three antimony lines are seen to lie. Dr. Roscoe must be thanked for making this valuable continuation so soon accessible to English experimenters.

NOTICES OF PATENTS.

2835. *Improvements in Waterproofing, and in Recovering Products employed therein.* R. A. Brooman. Fleet Street, London. A communication. Dated October 21, 1862.

For the purposes of waterproofing, the inventor dissolves India-rubber, gutta-percha, resins, or metallic soaps, with or without sulphur, in bisulphide of carbon, ether, or other suitable and volatile solvent. Having placed one of these solutions in a vessel capable of being made air-tight, and immersed the fabrics or other articles to be waterproofed therein, the cover is adapted, and the goods withdrawn through an air-chamber into an adjoining receptacle; the communication being then closed, heat (by warm water) is applied to the second chamber; and whilst the solution is dried in the pores of the fabric, the solvent is recovered by distillation, and may be employed again repeatedly for similar purposes.

2852. *Salinometer.* W. S. Gamble. Islington. Dated October 23, 1862.

This name is applied to a kind of hydrometer fitted to and employed in connection with a steam-boiler for the purpose of indicating the density of its liquid contents. It carries within itself a small thermometer to show the degree of temperature, and the whole floats without a compound glass and metal cylinder, the graduations being read off from the front shortly after the admission of the water by a three-way cock.

Notices to Proceed.

2260. Charles Battcock, Wandsworth, Surrey, "Improvements in cigar lighters and fusee matches, part of said improvements being applicable also to vestas and matches, wax tapers, and candles."

2262. Warren Thompson, Rue Neuve des Martyres, Paris, "Improvements in electric telegraph apparatus."—Petitions recorded September 15, 1863.

3107. Thomas Vaughan Morgan, Battersea Works, Surrey, "Improvements in the treatment and purification of plumbago for the manufacture of crucibles and other fire-proof articles, and in apparatus employed therein."—Petition recorded December 9, 1863.

3232. James Shanks, St. Helen's, Lancashire, "Improvements in the manufacture of caustic soda and caustic potash."—Petition recorded December 22, 1863.

2283. Fedor de Wylde, Trinity Square, Tower Hill, London, "Improvements in the manufacture of an hydrated silica."—Petition recorded September 17, 1863.

2294. William Lorberg, Wyld's Rents, Bermondsey, Surrey, "Improvements in the treatment of rags, and obtaining valuable chemical products from the animal fibre therein."

2354. William George Helsby, Liverpool, "Improvements in mounting or setting transparent photographic pictures."

2359. Alfred Vincent Newton, Chancery Lane, London, "Improvements in the manufacture of gunpowder, and powder for blasting purposes."—A communication from Alfred Nobel, Rue St. Sebastien, Paris.—Petitions recorded September 24, 1863.

CORRESPONDENCE.

Cohesion Figures of Liquids.

To the Editor of the Chemical News.

Sir,—In a generally accurate report of my Lecture at the Pharmaceutical Society, contained in your last number, there are one or two corrections required. You make me say, p. 79, col. 1, "In general only one drop should be allowed to fall, as the effects are not always the same; but, in the case of a very volatile liquid like ether, the figure of which lasts but a second, several drops may be dropped in succession from a tube as the figures disappear."

Now, I never intended to convey the idea that "the effects are not always the same," when the observations are made with chemically clean surfaces. What I said was, that in the case of a fixed oil, one, and only one drop must be deposited on the surface of the water; that in the case of some volatile oils a second drop will sometimes displace the film left by the first drop, and form a second cohesion figure; and that in the case of ether, alcohol, wood-spirit, &c., many drops may be allowed to fall from a dropping-tube in regulated succession on the surface of the water. I see where your reporter misunderstood me. I remarked that each operator would have what the astronomers call *his personal equation*, so that one man's result might differ in neatness and precision from that of another.

Again, the beautiful phenomena that accompany the castor oil figure do not "last some hours," but only some seconds. The residual film without colour or border does last some hours.

Another trifling correction is required in the case of the cod-liver oil figure. I said, in answer to a question, that I had obtained a figure from the reputed pure oil, which I will call A; that a different figure was produced from a specimen which I purchased at a shop, B; that on mixing one-third of A with two-thirds of common fish oil, I obtained a figure nearly identical with that of B.

I am, &c. C. Tomlinson.

King's College, London, February 15.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

J. Howarth.—Marine glue.

W. A. W.—1. Yes. 2. Silk is the best insulator.

The answers to several correspondents are unavoidably postponed.

Book Received.—Dr. Herapath's "Address on Chemistry, &c.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Decomposition of Iodide of Mercury, by H. Rose.[*]

Iodide of mercury is very easily decomposed by cyanide of potassium. To estimate the mercury in the iodide the following process may be adopted. The cyanide of potassium is first rubbed in a mortar with twice its weight of quicklime. A little carbonate of magnesia is then placed in a tube closed at one end; the iodide mixed with eight or ten times its weight of the cyanide, and lime is next introduced; then a layer of the cyanide and lime is added; and lastly, a little carbonate of magnesia is placed on the top; the tube is now drawn out and bent, and the extremity is made to dip into a receiver containing water. Heat is now applied to the mixture, beginning at the top, and the mercury distils over.

Other mercuric compounds may be decomposed in the same manner.

According to Carius, iodide of mercury is completely decomposed by digestion with nitrate of silver in a not very acid solution. The reaction is definite enough to allow of its being utilised for an estimation. Iodide of silver, like iodide of mercury, is slightly soluble in nitrate of mercury.

The red iodide of mercury may be reduced by a solution of protochloride of tin, but the reduction is not complete. With an excess of hydrochloric acid the reduction is impossible, and the iodide becomes yellow when the mixture is heated. When, however, the mixture is supersaturated with potash, the reduction takes place. Iodide of potassium will also prevent the reduction with protochloride of tin, unless an excess of potash is present.

Metallic zinc completely decomposes iodide of mercury in the presence of water, forming iodide of zinc.

On Some Mineral Waters of Nova Scotia, by Professor How, *D.C.L., University of King's College, Windsor, N.S.*

Little has yet been done in the chemical examination of the mineral waters of Nova Scotia from the want of a systematic geological survey of the Province. They are, as appears from the following notices and analyses, of varied character, and there would be much scientific interest in an extended and thorough investigation into their qualities and composition. At the same time, if the results were duly published, the medicinal virtues which reside in some of the waters would be made generally known. It is probable, too, that new medicinal springs might be discovered. This is obviously a matter of sufficient importance to the Province, both in a sanitary and economic point of view, to demand the care and attention of an enlightened government. Mineral springs have been, and are still, so frequently the sole means of rendering localities famous and wealthy, by attracting residents for more or less lengthened seasons, that it is well worth while to possess any water of great curative value, and to make its merits known as extensively as possible. Nova Scotia appears to be able to add valuable medicinal waters to her mineral resources awaiting exploration and development. I propose in the following paper to give some facts about these mineral springs, and the results of my analyses.

Bras d'Or Saline Water, Cape Breton.—This water has an extraordinary and apparently well grounded reputation for procuring alleviations and effecting cures in various maladies, authentic cases being known of much benefit resulting from its use in rheumatism and severe headaches. A gentleman of high standing and of scientific reputation informed me that he had obtained a good appetite and increased strength by taking about five gallons of it, and by further use a moderation of the violence of asthmatic attacks to which he was subject; in fact, that its employment had proved a real blessing to him. A water possessing such qualities would, of course, be much resorted to; and it was considered worth while to erect a house for the accommodation of visitors soon after the merits of this spring became somewhat known.

There appear to be three springs at this locality, situated "near Kelly's, on the high road from Sydney to St. Peter's, in a brook that empties into the Salmon River, distant some two or three miles from the source of the river, six or seven from the southern shore of the Bras d'Or lake." On referring to the map accompanying Dr. Dawson's "Acadian Geology," at about the spot so indicated, Devonian and Silurian rocks are found to come in contact with syenite and other igneous rocks; and I have direct information that the water rises in syenitic rocks. The flow is said to be not more than a gallon in a minute. Whether all the springs become mingled in one stream I do not know. The analysis which follows was made[*] on a quantity of the water most esteemed, I apprehend, for medicinal virtues. The amount at my disposal did not enable me to make a thorough investigation, so that, no doubt, I do not give all its ingredients. The results were calculated for the English imperial gallon of 70,000 grains.

The water was clear, and of neutral reaction.

	Grains.
Iron and phosphoric acid . . .	traces.
Carbonates of lime and magnesia .	0·60
Sulphate of lime	0·94
Chloride of sodium	343·11
Chloride of potassium . . .	4·55
Chloride of calcium	308·90
Chloride of magnesium . . .	4·47
	662·57

Specific gravity at 54° = 1007·397.

The carbonates of lime and magnesia were thrown down by boiling. It was assumed that two-thirds of the precipitate thus obtained consisted of carbonate of lime, and the calculation made accordingly. The precipitate was so small that no great error could arise in this way. No iodine was detected in the saline residue from 1500 grains of the water.

The composition of this water is very remarkable, quantities of sulphates and carbonates so very small being rarely met with. The large amount of chloride of calcium is also very unusual. On looking over a large number of analyses of mineral waters, belonging to different parts of the world, I find none to resemble the present, excepting certain Canadian waters analysed and described by Hunt.[†] These form the first of the six classes in which he has arranged the mineral waters of Canada, and are characterised by "containing chloride of sodium, with large portions of chlorides of calcium and magnesium, sometimes with sulphates. The carbonates of lime and magnesia are either present only in very minute quantities, or are altogether wanting. These

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[*] *Poggendorff's Annalen*, bd. cxviii., s. 165; *Bulletin de la Société Chimique*, January, 1864, p. 25.

[*] In the autumn of 1859.

[†] "Report on Geology of Canada," 1863, p. 531.

waters are generally very bitter to the taste, and always contain portions of bromides and iodides." It is also remarked, by the same authority,‡ that these brine springs are altogether unlike any hitherto studied; and particularly instanced are those of England, Germany, and the State of New York, in which the chloride of sodium greatly preponderates, and which are supposed to arise from the solution of rock salt. The brine springs of the Lower Silurian limestones (such as the Canadian waters in question), on the contrary, may be supposed, according to Hunt, to represent the composition of the ancient ocean in which these early strata were deposited. I have mentioned that the Bras d'Or water is said to arise in syenitic rocks. Crystalline limestones may exist at the locality. I have seen them in some parts of the rocks of Cape Breton coloured of the same tint in Dawson's map.

2. **Renfrew Brine Spring, Hants Co.**—This spring flows near the gold diggings of this place. I found it to yield about 1439 grains of solid matter to the imperial gallon, consisting principally of chloride of sodium, with but a small proportion of earthy salts.—[In 1862.]

3. **Brine Spring of River Philip, Cumberland Co.**—A spring exists here affording a dry salt of good taste and colour, some pounds of which were sent to the Exhibition at London in 1862. No information was furnished as to the spring; it arises, no doubt, in carboniferous rocks, in which formation salt springs are known to exist in several parts of this and other countries. Nothing, however, has yet been done in their examination, and the River Philip spring is the only one, so far as I know, that has been turned to any account.

4. **Wilmot Springs, Annapolis Co.**—These, situated about 100 miles from Halifax, afford a water which has been much resorted to. The Rev. Dr. Robertson, rector of the parish of Wilmot, has obligingly furnished me with the following information:—The water of the Wilmot springs is cold, with an abundant flow, and is highly charged with mineral substances, chiefly iron and copper (?) No correct analysis of it, I rather think, has yet been made. It is said to contain a small proportion of iodine. In former times the springs were much frequented, but of late years very few visitors have come to them. The water, however, is remarkably efficacious in curing cutaneous complaints or eruptions. In my own opinion, the Wilmot springs deserve to be better known and more frequented than they are at present. If the proprietors were men of substance and energy, I have not a doubt but that their locality would be one of the best known places in all Nova Scotia."

5. **Thermal (?) Spring, near Chester, Lunenburg Co.**—Amos F. Morgan, Esq., has furnished me with the following details of a spring of clear water, issuing in the centre of a rising ground or small hillock in the woods in the neighbourhood of Chester. The temperature of the atmosphere at the time of finding the spring, in the beginning of March, was below the freezing point; but of the water, as far as could be judged, about that of new milk, the pool having no appearance of having been frozen over the whole winter. The basin filled with the water was considered to be about eight feet square. The mud at the bottom was covered with small holes about the size of a man's finger, and out of these rose continually bubbles of gas. The water tasted slightly bitter, or perhaps was imagined to taste so, but was peculiarly soft, so much so, that it felt more like oil than water in the mouth. It is possible that this water is decidedly thermal; and it would seem, from its described taste and oily character in the mouth, to be highly alkaline. The gas arising appears to be abundant. This water would be well worth investigation.

6. **Spa Spring Water, Windsor, Hants Co.**—This is a water rising in a field in a district in which gypsum is one of the prevailing rocks, the geological age being Lower Carboniferous.

The water has long been considered chalybeate, and has been taken medicinally by a number of persons, with what effect I do not know. It is well known as a favourite drink for horses and cattle. The chalybeate character of the water was inferred from its possessing a strong inky taste, and also from a certain red deposit found in the conduit pipes through which it ran, both of which were justly attributed to the presence of iron. There is, however, very little iron in the water as it issues from its outlet, as is seen in the following analysis made of the water carefully collected in a small reservoir, filled immediately from the spring rising beneath.

The water was perfectly colourless and clear; it had little taste, and that not inky; its temperature was 49° F., that of the air being 31° (so that it is slightly thermal; compare "Geol. Can.," p. 564.) It afforded the following constituents in an imperial gallon. (December, 1858):—

	Grains.
Carbonate of lime	17·50
Carbonate of iron	0·40
Carbonate of magnesia	0·31
Sulphate of lime	106·21
Sulphate of soda	0·68
Sulphate of potassa	0·38
Sulphate of magnesia	11·02
Chloride of sodium	0·90
Phosphoric acid and organic matter	traces
Silica	0·60
Grains in a gallon	138·00
Free carbonic acid (1·35 cubic inch at 33°)	0·64
Specific gravity at 49° F.	1001·358

This water would be placed in the sixth class of Hunt,§ being rich in sulphates. The sulphate of lime (derived, no doubt, from the prevailing gypsum), which is the characteristic ingredient, is present in larger amount in only one out of fifteen waters from Cheltenham, in England, and is by no means a common constituent of waters in such large proportion. The water is known to possess purgative properties when taken freely, owing in part, no doubt, to the sulphate of magnesia present. The inky taste and the red deposit from the water are due to its action on the soil, and to its admixture with surface water, and are only observed when precautions are not taken to keep the spring-water pure. The chalybeate impregnation thus obtained is, of course, valuable, but will be subject to variation.

From the well-marked characters of the waters mentioned in this paper, it is evident that, in a systematic survey of the Province, the inquiry into its mineral springs would form a very interesting and useful part of the work involved in so desirable an undertaking.

On the Purification of Sulphuric Acid,

by F. Maxwell Lyte, *Esq.*

The result of several experiments in my laboratory, suggested by inquiries from correspondents of the Chemical News, as to the best means of obtaining sulphuric acid entirely free from arsenic, fully bear out the fact recorded by MM. Bussy and Buignet, viz., that arsenic, in order to pass during distillation, must be

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‡ *Loc. cit.*, p. 563.

§ "Report on Geology of Canada," 1863.

present in the state of arsenious acid. I have, however, been led to employ a different mode of purification, chiefly with a view to ensuring the complete absence of all nitrous products, and obtaining a pure acid from the very first, and of thereby obviating the necessity of changing the receiver,—a most dangerous operation when distilling sulphuric acid. If the acid contains nitrous compounds, I heat it in a porcelain capsule to a temperature of about 110° C., with a small portion of oxalic acid, till the latter is completely decomposed, and all effervescence has ceased; about $\frac{1}{4}$ to $\frac{1}{2}$ per cent. is amply sufficient for nearly all samples of commercial acid. It is best to add the oxalic acid before heating, and to stir constantly till the reaction is completed. I now allow the acid to cool down to about 100° C., and add to it a solution of bichromate of potassa in sulphuric acid, or some of the salt itself in fine powder, until the pure green colour at first produced by the formation of sesquioxide of chromium is replaced by a yellowish green, indicating an admixture of chromic acid in the free state. The acid so prepared, being now distilled, passes from the first perfectly free from all impurity. The addition of the bichromate has another advantage, viz., that if it be first of all applied to a small sample of the commercial acid, it indicates the presence of free sulphurous acid, as well as of arsenious acid, and either of these being present, we may presume on the absence of nitrous compounds.

No doubt permanganates would answer equally well; but the bichromate of potassa, which is cheap and easily procured, is so convenient and inexpensive as to leave nothing to be desired.

Bagneres de Bigorre, February 15.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

(*Continued from page* 87.)

Acidum Arseniosum.—The British Pharmacopœia follows that of the Dublin College in directing the arsenious acid of commerce to be resublimed for medicinal purposes. This is undoubtedly necessary if by the acid of commerce we are to understand the arsenic in powder commonly sold, which is often largely adulterated. The vitreous acid described by the London College in 1851, and which will always be supplied by wholesale houses, is, however, sufficiently pure, and another sublimation is quite unnecessary. Two tests are given for ascertaining the complete purity of arsenious acid, which can be applied by the pharmaceutist to the vitreous acid. The first is the complete volatilisation by heat. The second is a volumetric method by means of a normal solution of iodine. This methed is based upon the fact that, when arsenious acid is brought into contact with iodine in the presence of water and an alkali, it is converted into arsenic acid. Four grains of arsenious acid are directed to be dissolved with eight grains of pure bicarbonate of soda. The quantity of alkali is not important so long as there is at least double the amount of arsenious acid present, such a proportion being necessary to combine with the hydriodic acid set free. The ultimate results of the reaction are expressed in the equation, $AsO_3 + 2I + 2NaO = AsO_5 + 2NaI$.

The volumetric solution of iodine is to be made by dissolving 111·125 grains of pure iodine and 150 grains of iodide of potassium in sufficient water to make a pint. 100 measures of this solution will contain one-tenth of an equivalent, or 12·7 grains of iodine; consequently, 80·8 measures will be necessary to oxidise four grains of arsenious acid. The iodine solution is directed to be added to the alkaline arsenical solution as long as the colour is discharged. A plainer indication of the termination of the reaction is, however, obtained by following the plan recommended in all books on volumetric analyses, where a little solution of starch is directed to be added to the arsenic solution. The smallest excess of iodine is then distinctly seen by the production of the well-known blue colour.

The same method is employed for determining the strength of the solution of *Acidum Sulphurosum*. The exact strength of this solution can hardly be a matter of much importance, but the Pharmacopœia intends a saturated solution of the acid in water, which will have the density 1·04. "One fluid drachm of this solution mixed with a little mucilage of starch does not acquire a permanent blue colour with the volumetric solution of iodine, until 164 measures of the latter have been added to it."

These directions are incomplete in one important but very obvious particular. It is omitted to be stated that the acid must be considerably diluted with water, or the analyst will probably be led into error. With dilute solutions of sulphurous acid the following reaction takes place:—$SO_2 + I + HO = So_3 + HI$; but Bunsen has shown that with a concentrated solution the reaction is in a short time reversed:—$SO_3 + HI = SO_2 + I + HO$. Strict accuracy, moreover, cannot be expected with a measured quantity. Fluid measures are seldom graduated with accuracy, and no two persons would probably measure exactly the same quantity. A fluid drachm besides requires 164 measures of the iodine solution, which involves filling the burette twice, or the employment of two. It would have been better to have directed a weighed quantity to be employed, although in that case a loss of acid would be experienced in consequence of the exposure. As we have said, however, the exact strength of this solution of sulphurous acid, so long as it is somewhere near the point of saturation, cannot be a matter of much importance.

The process given for tannic acid is one which may be easily applied to the production of the article on a small scale, but which no manufacturer would think of applying on a large. Its adoption by the Committee is somewhat surprising, since a good manufacturing process was offered to them by an experienced maker. The method more generally employed is the following:—Finely powdered gall-nut is made into a stiff paste with ether and water—one pound of galls require twenty ounces of ether and four ounces of water. This paste is placed in a canvas bag, and is then submitted to pressure. A thick solution of tannic acid is thus squeezed out, which only requires careful drying. To obtain the acid in the light vesicular condition in which it is found in commerce requires careful manipulation. It is best dried in small portions in a current of heated air, or the heat may be applied above the acid. A little gallic acid is no doubt obtained by the above process, but the amount is small, and can be of no importance.

The process for tartaric acid may be recommended to any pharmaceutist who cares to amuse himself by making a little of this acid, or who wishes to instruct an apprentice. A manufacturer of the acid on a large scale would be more likely to employ the process we recently quoted from Dr. Hofmann's "Report on the International Exhibition." The inquiry again suggests itself—Why the compilers of the Pharmacopœia troubled themselves at all about these processes, well knowing that they would never be followed?

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture VI.—*Saturday, January* 9, 1864.

Ladies and Gentlemen,—I have one or two further remarks to add concerning the production of felspar. According to Daubrée, when china clay, of which we shall speak by and by, is heated to a very high temperature in water containing silicate of soda, a double silicate of alumina and alkali is formed which has all the characters of felspar. Daubrée remarks that possibly the Sangenhausen felspar, of which I showed you some crystals on the last occasion, may have been produced by aqueous agency, although a furnace product. He seems to labour under a mistake in asserting that these crystals were obtained at the upper part of the furnace. The contrary is the fact. They were obtained below, in the hearth, at or near the bottom of the furnace. That, I think, is a very important point to bear in mind.

I also omitted to mention a singular product which may be obtained from our blast furnaces on a very large scale, and resembling pumice in character. If a small stream of common slag, of which you saw several specimens at the last lecture, be allowed to flow into water, it becomes puffed up into a light and remarkably porous body, very similar, indeed, in external character, to pumice, and suggesting, in fact, the mode in which pumice may have been formed. This white specimen was obtained in my presence in South Wales from a slag, which, allowed to consolidate in the ordinary way, is perfectly black, but which, owing to this fine state of division, is white. When breathed upon it emits an odour of sulphuretted hydrogen, owing to the presence of sulphide of calcium.

The next compound to which I have to direct your attention is mica. The formula of this body is

$$3RO,2SiO_3+2(Al_2O_3SiO_3).$$

The RO base is of the lime or potash type. You will remember that $3RO,2SiO_3$ is the formula expressive of wollastonite. The oxygen of the silica in mica is equal to that of the alumina series. Mitscherlich found magnesian mica in an old slag heap in Sweden; and Hausmann is also said to have found mica in cavities of sandstone from the hearth of a blast furnace, which previously showed no trace of mica. I have examined several specimens from such hearths, but I have never found any trace of mica in them. Daubrée informs us that he produced uniaxial mica in hexagonal scales from clay in superheated water, containing silicates dissolved. These are all the facts which we know at present concerning the artificial production of mica.

I will direct your attention for a few moments to another silicate of great interest, especially in an economical point of view. I allude to ultramarine, which is a compound of silicate of soda and alumina. This remarkable body, which has such a fine colour, may be artificially produced, and is now prepared, in fact, on a very large scale as a chemical product. Chemically, it is identical with the native mineral, though certainly, in other respects, it is inferior to it. The quality of the tint, I think, and also certain other physical points connected with it, distinguish it from native ultramarine. It was accidentally found in a soda furnace a great many years ago by Guimet.

It is made by heating carbonate of soda and China clay with an excess of sulphur, under certain conditions as to temperature. It may be made with great facility in covered crucibles, by keeping them heated for about three or four hours at a tolerably red heat. You obtain thus a greenish product. Here is some of it; but it becomes blue on roasting with access of air. There is considerable difficulty in producing the right quality of tint, as there is with almost all colours. I have made a great many experiments upon this subject, occupying several months. Here are several of the products obtained directly in the manner described. The colouring principle is still very mysterious. Sulphide of iron is, no doubt, in some way or other connected with it. What the precise chemical principle is, we are not able to assert at present with any degree of certainty. The colour depends evidently upon the presence of a small quantity of sulphide of iron, which is one of the constituents. It is immediately discharged on the application of an acid, sulphuretted hydrogen being evolved, and the whole mass being rendered colourless. In the native *lapis lazuli*, or ultramarine, you will almost always observe the association of iron pyrites.

The hydrated silicates, which we have next to consider, occur abundantly in nature, and constitute some of the most beautiful minerals which adorn our mineralogical collections, as, for example, the extensive family of zeolites. They occur especially in the cavities of rocks of igneous origin, as well as in sedimentary beds—stilbite and apophyllite, for instance, in the fresh water limestones of Auvergne. Hydrated silicates are also met with in fossiliferous limestones in Scotland. These silicates lose their water when exposed to a good red heat; yet Bunsen has shown, by experiment, that it is possible to produce a silicate at a bright red heat which contains water. He took two parts by weight of lime and ten of silica, and mixed them intimately together. He then put them into ninety parts by weight of molten caustic potash, keeping the whole at a bright red heat for some time, and allowed the mixture to cool slowly. In this way a white product is obtained, which, when put into water, forms beautiful white crystals of a silicate of lime containing water, the excess of potash dissolving out. We have repeated this experiment, using for the purpose a gold crucible, which is now a common vessel in our laboratories. Here is the result. This is most distinctly crystallised, though it has lost a little of its water. It has the formula to which I have had occasion to refer so frequently—namely, that of wollastonite *plus* a small quantity of water, the amount of which is not distinctly stated. The formula is,—$3CaO,2SiO_3+Aq$, the oxygen of the silica being double that of the lime. Possibly the crystals may have been hydrated by the action of the water. This silicate loses all its water at a red heat, after the potash in which it was formed is dissolved out. I should observe, that molten caustic potash may retain water, even at high temperatures. In fact, the water cannot be expelled by heat alone. It might be urged, that the silicate of lime produced is at first anhydrous, and subsequently, as I have said, becomes hydrated by the action of the water. Some hydrated silicates are decomposed with more or less rapidity by exposure to the air. The well-known mineral, laumonite, undergoes decomposition on exposure to the air, and becomes opaque and pulverulent in mineralogical cabinets. Many hydrated silicates, on the other hand, are not thus decomposed. The composition of laumonite is $3CaO,2SiO_3$ *plus* three equivalents of silicate of alumina of the formula $Al_2O_3,2SiO_3$, and twelve equivalents of water. But even anhydrous, as well as hydrated, silicates undergo slow decomposition by exposure to the air. Take the familiar case of common glass. It is no uncommon thing to obtain specimens of glass from old buildings, which present most singular results in respect to corrosion. I have specimens which present numerous small spherical cavities more or less regularly diffused over the whole surface. The anhydrous silicates which are especially subject to the decomposing influence of the atmosphere are those which contain much alkaline base. Felspar is thus decomposed, forming kaolin—an amorphous hydrated silicate of alumina, the potash being washed away as silicate, or as silicate and carbonate, with the separation of more or less silica. At high temperatures water exerts a strongly decomposing action, even upon silicates like glass. I have already referred to some of the results of this action. We shall have further to consider it by-and-by.

In nature there is strong evidence for supposing that all hydrated silicates result from the action of water percolating through rocks. In many volcanic rocks—rocks clearly of igneous origin—cavities abound, containing, as I have said, beautiful crystals of hydrated silicates. Well-known specimens of such crystals abound in all our mineralogical cabinets.

With regard to the formation of these hydrated silicates, I have first to call your attention to some extremely interesting, and, as it appears to me, important observations by Daubrée, who has given us the results of experiments which have now lasted for at least two thousand years, and his remarks are in every way remarkable and deserving of attention. At Plombières are the remains of Roman works, constructed with a view to carry off the thermal waters there, the highest temperature of which is from 70° to 73° centigrade. Under the pavement of the streets, also, at a great depth, are subterranean conduits or aqueducts, of which the objec twas to intercept the thermal waters, and convey them to reservoirs. Where the waters emerged, the Romans made a bed of concrete, but without sand, using lime, fragments of brick, and sandstone (*grès bizarré*.) This bed of concrete extends more than ninety metres in length, and in some places to the depth of not less than three metres. It rests occasionally directly upon the granite of that region, but for the most part is separated from it by a bed of alluvial gravel. By the long-continued action of the thermal waters, singular chemical changes have taken place, and zeolites, together with other minerals, have been produced. They occur especially in cavities in the mass, in which they form mamillated and sometimes crystalline incrustations. In the granite, subject to precisely the same conditions as the brick and mortar, no zeolites were detected. There are in the museum specimens from this place.

Daubrée has detected several compounds in this concrete. The first to which I shall call your attention is the well-known mineral apophyllite—undoubtedly one of the most beautiful minerals in the world. It crystallises in the pyramidal system. It has the same formula as wollastonite, namely, three equivalents of base of the RO, or lime type, two equivalents of silica, and two of water; but the base consists of potash and lime, and the relation of the potash to the lime is as one to eight—eight equivalents of lime to one of potash — $3RO,2SiO_3 + 2HO$. Fluor is mentioned in small proportion in many analyses. Daubrée found the apophyllite lining small cavities in the calcareous part of the concrete. It has precisely the same crystalline form as the native mineral. In fact, it is in all respects identical with it. The thermal waters at Plombières contain an alkaline silicate, and by the action of this water flowing over the carbonate of lime during these twenty centuries, apophyllite has been formed. We have the carbonate of lime in the concrete, the silicate of potash in the water, and all the elements requisite to constitute apophyllite; and, accordingly, we have it produced. The proportion of the silicate of potash in the water may be very small, but the water has been perpetually renewed. The stream has continued to flow over the concrete, and in time the mineral has been formed on a somewhat considerable scale.

Native apophyllite occurs precisely in similar conditions. It is met with in cavities, and in veins, in transition slate, in amygdaloidal rocks, and in basalt; in fact, precisely in such conditions in which water may have operated by percolation, as it has done in the production of the artificial mineral at Plombières.

Another mineral which Daubrée has found produced in these curious remains of Roman workmanship is the well-known substance called chabasie. It is rhombohedral, approximating to the cube in point of form. The first part of its formula is the same as in apophyllite—a silicate of the RO base. Then there are three equivalents of a silicate of alumina, *plus* 18 of water—

$$3RO,2SiO_3 + 3(Al_2O_3,2SiO_3) + 18HO.$$

Now, this base (RO) is represented by lime, soda, and potash, $RO = CaO,NaO,KO$. In many of the cavities in the bricks were perfectly colourless and limpid crystals of chabasie, exactly similar to the native mineral in all respects. They presented slight striations parallel to the edges like many of the native crystals, and also the usual macle in some cases. The crystals were measured, and found to present exactly the same characters as native specimens.

Daubrée tells us that he detected other zeolitic minerals, but has not yet proved their identity with native species, not having been able to obtain them sufficiently pure and in sufficient quantity for analysis. In several cases he has observed the chabasie crystals studded over with microscopic crystals, similar in all respects to a mineral termed gismondine; and, more rarely, needle-like scolezite occurs, and also a few prisms like harmatome. The thickness of these zeolitic incrustations is not more than about $\frac{4}{100}$ths of an inch; so that, after all, the crystals are but microscopic, but still they are identically the same in character as those occurring in nature. The size is a question of time. If we can get crystals of this size in 2000 years, we can, of course, get them proportionately larger in 100,000 years; and even 100,000 years is a short period in a geological point of view.

In cavities at the lower part of the bed of masonry, and near the points which receive a direct jet of thermal water, occur tolerably copious, gelatinous, transparent, and colourless deposits, the substance of which becomes, on drying in the air, opaque, snow-white, and mamillated, presenting the appearance of concentric layers, which are fibrous in fracture, and highly suggestive of the structure of malachite, or certain kinds of brown hæmatite, with which every geologist is familiar. This substance gelatinises with acids. It has a simple formula—one equivalent of lime, one of silica, and two of water, so that the oxygen of the silica is three times that of the lime:—

$$CaO,SiO_3 + 2HO.$$

Along with the minerals which I have just mentioned, Daubrée has found hyalite, which we studied in a previous lecture. It could not be distinguished from that found in basalts. He also discovered a variety of common opal, or a substance exactly resembling opal in all respects, having a greyish colour, and resinous lustre. He found arragonite and calcspar associated with chabasie, as in the volcanic rocks of Iceland. There was also fluorspar, white, and occasionally of a violet tint, occurring often in the vicinity of apophyllite, which itself frequently contains fluor. There is no difficulty in accounting for the presence of this fluorspar, for the water of Plombières was found to contain fluor. I spoke to you, on a former occasion, of the solubility of fluor spar in water. He also met with what he believed to be a new species of salt,—a hydrated carbonate of magnesia, though that fact is not ascertained at present, the quantity obtained being too small for analysis.

Here, then, we have a number of minerals produced, apparently, in the same conditions. These zeolites do not occur exceptionally, but in every part of the concrete traversed by the thermal waters. I think you will agree with me, that not only the identity of these zeolites, in their physical and chemical characters, with those occurring in nature, but also the apparent identity of the conditions under which both have been formed, is exceedingly interesting and instructive to the geologist. These conditions are of the most ordinary kind. There is no necessity whatever for the assumption of the agency of water at very high temperatures, and, consequently, under very great pressure, although, in some cases, there can be little doubt that these conditions have obtained. Wöhler dissolved and crystallised apophyllite in water at 180° centigrade, under a pressure of ten atmospheres. But we see that, under ordinary conditions, some of our most beautiful minerals have been generated simply by the action of a mineral spring operating, century after century, upon a common bed of concrete. Daubrée observes that, notwithstanding the extreme hardness of the Roman masonry, it was yet pervious to the thermal waters by cavities, by fissures, by the substance of the mortar itself being porous, and especially by the innumerable blisters produced in the bricks by burning. It is curious that such distinct minerals should be formed close to each other in conditions apparently so similar,—from the same matter under the action of the same thermal water. Daubrée remarks:—"If it were not for the difference of colour, it would even be very possible to confound parts of the concrete charged with zeolites with basaltic tufas, in which the same minerals have been formed. The bricks, with their '*boursoufflures*' and their drusy cavities, imitate, in a surprising manner, amygdaloidal rocks. Such an identity in results incontestably reveals great analogies in origin."

We now come to the transformation of glass into zeolitic substances by means of superheated water. I spoke to you on a former occasion of the action of water at a high temperature—400° centigrade—and, therefore, under great pressure, upon glass. Daubrée finds, that when the temperature is lower, the products are different. He obtained a hydrated silicate, which retained some of the alkali, by the action of water at 200° centigrade. The form of the glass was preserved, but the glass itself increased in volume about one-third, and became opaque and snow-white. It is found to be very decidedly fibrous in structure. It is easily fusible, and completely decomposable by the action of acids—hydrochloric acid, for example—even without the aid of heat. Its composition, after washing well with boiling water, and then drying at 100° centigrade, was very analogous to the mineral called pectolite, which occurs in spherical masses, consisting of delicate radiated fibres. It contained—

Silica	61·8	per cent.
Lime	21·9	,,
Magnesia . . .	3·9	,,
Soda	6·3	,,
Water	4·2	,,
	98·1	

and traces of alumina. By the action of water at 400° centigrade, Daubrée, it may be remembered, obtained a multitude of minute crystals of quartz, and also wollastonite in acicular crystals. This, again, is important, as showing that different products may be obtained from the same silicate of soda and lime by the operation of water at different temperatures.

The hydrated silicate, to which I have next to direct your attention, is one which abounds in nature—namely, clay. I intend to speak of clay only chemically. It is essentially a hydrated silicate of alumina—a silicate of alumina combined with water. The water cannot be expelled at a very gentle temperature—for example, by boiling. By exposing it to a boiling temperature, you may drive off what is called the hygroscopic portion of the water—that which forms no part of the essential constitution of the clay, but the water of combination is expelled at a higher temperature. Upon this water of combination depends the plastic property of the clay, and when it is driven off, the fictile property of the clay—or its power of being moulded—is lost. When the water of combination has been once removed by a high temperature, the clay cannot regain it by the addition of water.

Apparently great varieties of clay occur in nature, but they are all reducible to one or two simple formulæ. The various kinds of this hydrated silicate are due chiefly to the admixture of foreign matters. I shall take, as a typical example of all clay, kaolin, or China clay, which occurs in Cornwall, and I shall show you how it may be derived from felspatic rocks. There are many analyses of this clay which are very nearly concordant. I will give you one of the most reliable of China clay from Cornwall:—

Silica	46·32
Alumina	39·74
Water (combined) . . .	12·67

Those are the essential ingredients. The accidental ingredients which are more or less frequently found in this clay in small quantity, but which are unessential, are—

Lime	0·36
Magnesia	0·44
Oxide of iron	0·27

This is one of the published analyses. I have not the slightest doubt that there is an omission here, for in all the clays which we have examined a sensible amount of alkali is present; but unfortunately the determination of alkali involves a great deal of trouble, and chemists will not incur it unless they have reason for doing so, and wish, for some scientific purpose, to work out the analysis properly.

Such, then, is the composition of China clay, which is so extensively used by the potters. Let us see how this China clay may be derived from felspar. We know that it may be so derived, because we can distinctly trace the progress of its formation in Cornwall and elsewhere. We will take, first of all, the formula of felspar, which consists, you will remember, of a silicate of potash combined with a silicate of alumina. We require two equivalents of felspar, and, to make the formula quite plain, I will express it in this way—$2KO + 2Al_2O_3 + 8SiO_3$. You will find that that represents exactly two equivalents of felspar. If we then deduct from those two equivalents of felspar two of potash and five of silica, we get the formula of kaolin, or one of the formulæ most generally adopted as expressive of the composition of kaolin—$2Al_2O_3 + 3SiO_3$. The formula is not thoroughly settled by chemists, but the one I have given is not far from the truth. Thus, two equivalents of potash and five of silica have to be removed from the felspar. The silica may go off partly as silicate of potash, and possibly partly in a free state. There is, then, no chemical difficulty whatever in understanding how kaolin should be derived from felspar, and there is no doubt whatever that kaolin and all other clays have proceeded from some rocks of this kind.

I will make some special observations on a few important clays which abound in this country, especially in our coal measures, and which possess highly refractory properties, or, in other words, resist high temperatures. These are termed fire clays. They consist essentially of hydrated silicate of alumina. We have examined many of them, and in all we find a considerable amount of silica in the form of sand. I will give you the composition of one of the most refractory of these clays, which is extensively used by glass makers in making their pots. It is a Stourbridge clay of best quality:—

Silica	65·10
Alumina	22·22
Potash	0·18
Lime	0·14
Magnesia	0·18
Oxide of iron	1·92
Phosphoric acid	0·06
Organic matter	0·58
Water (combined) . . .	7·10
Water (hygroscopic) . . .	2·18
	99·66

The silica exists partly—in fact, the largest part—combined with alumina, and partly in the form of grains of sand. The sand may be separated more or less completely by the process of levigation, that is, by triturating the clay, and then suspending it in water. The particles of clay being finest, will remain longest suspended, and the particles of sand will go to the bottom. Potash is present in the clay to a small extent, and possibly a little soda too. I venture to affirm that in every clay, without one exception, if due search be made, potash will be found—frequently in company with soda. In some fire-clays it is found to the amount of 2 per cent. Soda has been detected to the extent of 3 per cent. Magnesia also is always, or almost always, present. Frequently these clays contain iron pyrites diffused through the mass, and this is a source of great inconvenience to brick-makers. The pyrites becomes oxidised in the burning, and acts injuriously upon the clay, covering the bricks with small black spots. Phosphoric acid is present, as we might expect. In analyses of clay for commercial purposes several of these ingredients are omitted, such as the phosphoric acid and the alkali. In the analysis given the organic matter amounts to only about one half per cent., and consists, probably, of bituminous, or coaly matter. The water combined with the clay is that which cannot be displaced at a temperature, say, of 100° centigrade, or even much higher. The hygroscopic water is that which can be displaced by dessication at a comparatively low temperature. These clays are very often dark in colour, and unctuous to the touch. Whatever varieties clays may present in external characters, they are, in a chemical sense, extremely similar. I have endeavoured to explain how clays may be derived by the conjoined action of water and carbonic acid upon rocks—such as felspar—during long periods of time.

I have placed before you a number of illustrations of hydrated silicates—silicates produced by double decomposition—the decomposition of silicate of soda by various metallic salts. We have here, for example, a pale blue silicate of copper so produced. This is a true and certain combination of silica and oxide of copper. We find on boiling it that there is no change of colour, as would be the case if there were no combination with silica, and the blue colour were due to hydrated oxide of copper. Then we have a silicate of cobalt and a silicate of iron produced in the same way. In the formation of this silicate of copper, a double decomposition has taken place. The silica of the silicate of soda has left the soda, and gone to the copper, and the acid of the salt of copper has left the copper, and gone to the soda. Here is a specimen of silicate of lead. It is perfectly hard, and gelatinous, like a very strong soap.

We will now proceed with another branch of our subject, and one of great interest—namely, sulphur and the sulphides.

Sulphur appears to have played a very important part in the economy of this earth. We find it occurring native; we find it in combination with metals, forming various sulphides; and we find it as sulphuric acid in combination with lime, forming gypsum, and with other bases. It occurs also in mineral waters as sulphuretted hydrogen; and it is evolved from volcanoes in the form of sulphurous acid, as well as in the form of sulphuretted hydrogen. With its properties generally, I must take it for granted that you are familiar. We all know it in the form of common brimstone, which, when heated sufficiently, takes fire upon access of air, and continues to burn, producing sulphurous acid. Sulphur has a very powerful affinity for many metals. This is the case with respect to iron, lead, and copper. Some sulphides may be exposed to any degree of heat without access of air, and yet remain permanent, undergoing no trace whatever of decomposition. This is the case, for example, with sulphide of lead, and certain sulphides of iron. There are sulphides which are partially decomposed by heat alone. For instance, iron pyrites, when strongly heated in a close vessel, loses about half its sulphur. There are others, again, which are wholly decomposed, when heated, without access of air, as sulphide of gold; but this sulphide has never been found in nature.

Metallic sulphides differ very much—especially in external character—according to their mode of preparation. We have them in the amorphous state, and we have them well crystallised. By precipitation from solution, they are generally—or, at all events, in the laboratory of the chemist—thrown down in the amorphous state. Here is a specimen of a nearly white powder, which is a compound of sulphur and zinc, rapidly produced by precipitation from solution. Here is one of the same sulphide which has a crystalline structure, and is entirely different in outward appearance from that rapidly produced. Here, again, are two sulphides of antimony. They are identical in chemical composition, and yet the two are extremely dissimilar in their external characters. One has been produced by precipitation, and the other is the same sulphide fused after precipitation. The one is an orange-red powder, quite amorphous; and the other, which is the same substance after fusion, presents the appearance of a metallic body, possessing a highly metallic lustre and crystalline structure. So, again, with sulphide of bismuth. This specimen is amorphous, thrown down from solution; and here is another specimen of the sulphide, which, after fusion, has become lustrous and highly crystalline.

The decomposition of some of these sulphides under certain conditions may be interesting to the geologist. There is one especially to which I will call your attention for a moment, namely, the sulphide of silver. It occurs abundantly in nature. If we take that compound, heat it, say to redness, and then expose it to the action of the vapour of water, or to a current of hydrogen, it is decomposed, the sulphur passing off, and metallic silver being left. The silver so left presents exactly the same form as those beautiful specimens of capillary native silver which occur in our mineralogical cabinets. Some of the sulphides which we find in nature undergo spontaneous decomposition. This is the case, for instance, with one of the sulphides of iron—white iron pyrites, a particular species of bisulphide. It decomposes, takes oxygen from the air, and forms the well known yellow mineral substance called *misy*. We have numerous examples of this in the museum. It is derived by the weathering of iron pyrites. It is a yellow substance, and is a basic sulphate of peroxide of iron. Again, we find iron pyrites, converted superficially into brown oxide of iron, but the elimination of the sulphuric acid generated may be owing to the action of bicarbonate of lime.

I shall first speak of iron pyrites. Although I have set apart a lecture expressly for iron, I must forestall that part of the subject in so far as relates to iron pyrites—a compound of the highest interest. It consists of one equivalent of iron and two of sulphur. There are two well-known, distinct mineralogical species, of which the composition per cent. is the same, but the crystalline forms are very different. The cubical variety is the one commonly met with; and it is that which is most persistent when exposed to the air.

I wish to draw your attention particularly to the conditions under which iron pyrites may be formed. There are some curious points relating to its occurrence in nature which depend upon these conditions. Iron pyrites may be formed directly by the dry way. There are several processes given in chemical books with which I need not trouble you. I wish to fix your attention especially on the proof of its formation in nature in the wet way—that is, by the agency of liquids. In the first place, we find it associated with minerals which are evidently of aqueous origin, and associated in such a manner that it is impossible that the iron pyrites could have been formed in any other way than by the agency of liquids. We find it not unfrequently occurring in clay iron ores, and in little cracks in the centre, even, of balls of ironstone. We find it constantly in coal. I have never yet examined a single specimen of coal which did not contain iron pyrites, the pyrites being sometimes interstratified with coal in little beds, sometimes existing in nodular masses, sometimes in exceedingly thin films, sometimes diffused in minute particles through the mass, and sometimes existing in a state of division so fine as to be imperceptible to the eye, but always capable of being detected by chemical analysis. Here is a specimen of cubical pyrites in the centre of a little ball of ironstone, which must have been produced entirely by aqueous action. Not only is there iron pyrites here, but also zincblende—sulphide of zinc; and it is impossible that that iron pyrites could have been produced there except by the agency of liquids. There is a well-known experiment recorded by Bischoff, and often repeated, of the artificial production of iron pyrites in a bottle containing the remains of an unfortunate mouse, which had been left for some years in a solution of green copperas. Distinct cubes of iron pyrites—very small it is true—are said to have been so produced. I hoped to have been able to present to you a repetition of this experiment. For some years I kept the remains of a rat in a solution of green copperas, but unfortunately the air got access. I did not find the slightest trace of iron pyrites, but, as I said, the experiment was defective, and therefore I attach no importance to it.

I will place before you a specimen of iron pyrites produced in the dry way. It is in minute cubes or octahedrons, and was prepared by heating a mixture of sesquioxide of iron, sulphur, and sal-ammoniac, at a temperature slightly exceeding that at which sal-ammoniac sublimes. For that process we are indebted to Wöhler. Some of the most beautiful specimens of crystals of iron pyrites I have ever seen are in the possession of Mr. Fox, of Falmouth. These crystals were first observed by Mr. Lowe, of the Chartered Gas Works. You will find his name in published works, but it has been spelt in the German fashion, with two dots over the o [ö]. The iron pyrites was produced by subliming, at a long-continued and dull red-heat, rough sal-ammoniac, containing sulphate of alumina, in vessels coated internally with clay. The crystals were found in connection with chloride of iron.

We have unmistakable evidence—first, that iron pyrites may be easily made in the dry way at moderate temperatures; and, secondly, that it may be produced by the wet way. In fact, it must have been produced by the wet way in many conditions in which we find it in nature. I may here direct attention to what Bunsen says on this subject in his admirable paper on the pseudo-volcanic phenomena of Iceland. I doubt whether the merit of this paper has been fully recognised by the geologists of this country. It is well known to chemists, that sulphide of iron, under certain conditions—for example, in the presence of an alkaline sulphide containing an excess of sulphur—appears, to a slight extent, soluble when in a fine state of division. It makes a green solution, which, on standing, deposits flocks of sulphide of iron. A condition like this appears to obtain in Iceland; and Bunsen suggests, and very properly, that it is exceedingly probable that iron pyrites may have been so produced. There is one curious point connected with this subject—namely, the connexion of gold with the pyrites. The association is pretty general. It is still a question whether the gold is wholly there in the form of metallic gold, or whether some of it may not exist as sulphide of gold in combination or association with the sulphide of iron. The gold is undoubtedly present as metallic gold to a considerable extent in most cases; but, from what I know, I am rather inclined to believe that its existence as sulphide of gold is probable to a certain extent.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"On the Non-Metallic Impurities of Refined Copper," by Prof. Abel.

CHEMICAL SOCIETY.

Thursday, February 18, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, and the several donations to the library announced and acknowledged, the Society proceeded to ballot for the election of the following gentlemen, all of whom were duly received, as Fellows, into the Society, viz.:—Anselim Odling, Benjamin E. R. Newlands, James Dearden, Henry Bassett, Alfred Henry Allen, William Sydney Gibbons, Esqrs., Dr. Campbell Morfit, and Thomas Stevenson, M.B.

The Secretary read a paper, by Mr. C. Greville Williams, "*On Acetanilide.*" After referring to the processes of Gerhardt and others, by means of which this body has hitherto been prepared, the author described a new mode of formation, in which aniline and acetic acid were simply cohobated in the presence of water; after boiling some time, the new product commences to sublime, and, by then charging the receiver, it may be collected in the form of white crystals. Its formula—C_8H_9NO—shows that one atom of water is liberated during the reaction, which may be thus expressed:—

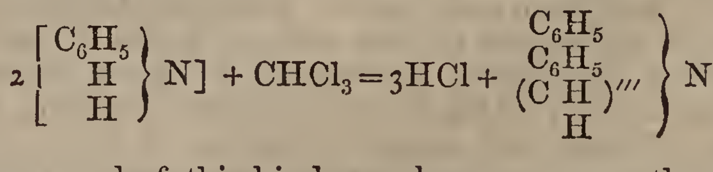
$$C_6H_7N + C_2H_4O_2 = C_8H_9NO + H_2O.$$

Acetanilide is a white, wax-like solid, which, when fused, has the specific gravity 1·099. It is soluble in ether, alcohol, and oils; from lemon oil it crystallises in beautiful needles. It boils at 195 degrees centigrade, and the vapour density, determined according to the method of M. St. Claire Deville, was found to be 4·847, whilst the number demanded by theory is 4·671. This result would have shown a closer agreement but for the separation of a small quantity of brown matter, which was left as a residue in the balloon. By the action of sodium, this amide yields aniline and an oily body not yet fully examined.

The President remarked upon the interest attaching to the author's communication, in consequence of the announcement of a somewhat unusual phenomenon, viz., the separation of water from the elements composing a salt by the action of heat upon its aqueous solution.

Dr. Odling stated that he received from Mr. Sydney Hall, of Swansea, a specimen of a white body which sublimes during the manufacture of aniline. Mr. Nicholson also had shown him the same substance. There is no doubt that these were acetanilide; and, in attempting to produce this same substance from the acetate of aniline, he found, contrary to the recommendation of Mr. C. Greville Williams, that the presence of an excess of *base* facilitated its formation. In fact, the substance in question was best prepared by the action of heat upon the acetate of aniline in a bath of aniline. In a similar manner he had already succeeded in producing benzanilide and hippuranilide by the action of heat upon the salts corresponding.

Dr. A. W. Hofmann stated that acetanilide had of late become for him the starting-point of a new series of researches. Some years ago he had been engaged in experiments on the action of chloroform upon aniline. When this base was digested with chloroform, it was found that the whole of the chlorine united with a corresponding amount of hydrogen, forming hydrochloric acid, whilst a new body was produced, which might be called diphenyl-formyl-diamine, thus:—



$$2\left[\left.\begin{matrix}C_6H_5\\H\\H\end{matrix}\right\}N\right] + CHCl_3 = 3HCl + \left.\begin{matrix}C_6H_5\\C_6H_5\\(C\,H)'''\\H\end{matrix}\right\}N_2.$$

A compound of this kind was known among the derivatives of ammonia. In fact, cyanide of ammonium to formyl-diamine is produced by the action of ammonia upon chloroform, and corresponds to the above aniline compound. Its formula may be thus written:—

$$\left.\begin{matrix}(CH)'''\\ H\\ H\\ H\end{matrix}\right\} N_2.$$

At this stage, the investigation was allowed to repose for a time; and it was only lately that some experiments with acetanilide, in which he had been aided by Mr. Tingle, had led him back to the former direction. He would remind the Society of the reactions by which, in contact with phosphoric acid or other dehydrating agent, acetate of ammonium loses one and two atoms of water respectively, becoming thereby transformed into acetamide and acetonitrile—

$$\text{I. } NH_3,C_2H_4O_2 = C_2H_5NO + H_2O.$$
$$\text{II. } NH_3,C_2H_4O_2 = C_2H_3N \quad + 2H_2O.$$

By distilling the acetate of aniline with phosphoric acid, the phenyl compound corresponding to acetamide was easily obtained; but by pushing the action of dehydrating agents further, so as to realise the second stage of the process, the results became complicated, and generally a charred mass only was the result. The case was different, however, when a hydrogenated body was present at the same time. Amongst other agents, the speaker had examined the action of pentachloride of phosphorus upon a mixture of aniline and acetanilide. Under these circumstances, very different phenomena were observed. By acting with pentachloride of phosphorus upon such a mixture, the hydrochlorate of a new organic base was obtained, the constitution of which was very closely related to that already mentioned as having been produced by the action of chloroform upon aniline. The following equation represented the formation of this salt:—

$$(C_6H_5)(C_2H_3O)HN + (C_6H_5)H_3N + PCl_5 = PCl_3O +$$
$$(C_6H_5)2(C_2H_3)'''HN_2,HCl + HCl.$$

This salt combines with one atom of bichloride of platinum. The base itself, diphenyl-acyl-diamine, is a magnificently crystalline compound, and is built up as follows:—

$$\left.\begin{matrix}C_6H_5\\ C_6H_5\\ (C_2H_3)'''\\ H\end{matrix}\right\} N_2.$$

Diphenyl-acyl-diamine is non-acid, forming a series of well-defined salts. The speaker pointed out the infinite variety of well-defined diamines which it was possible to produce by applying this process to the amides of the host of monamines already known; and other bases (*e.g.*, the ethyl bases) are likely to give similar results. The last papers of Gerhardt, published since his lamented death, indicate that he was working in this direction: his experiments were made by bringing the chloride of phosphorus in contact with the amide itself; whereas the method which the speaker proposed to adopt was that of employing mixtures, so as to weld two molecules of the same monamine, or two different monamine molecules into one single compound of a higher order.

Dr. Odling having inquired how acet-diamine should be viewed in relation to the new base—

Dr. Hofmann resumed the subject by pointing out that Mr. Strecker had shown that acetamide yet retained to some extent its basic character, and compounds, both with hydrochloric acid and nitrate of silver, were known. By distilling the hydrochlorate of acetamide, Mr. Strecker had obtained the hydrochlorate of a base called ace-diamine, related to diphenyl-acyl-diamine, as cyanide of ammonium to diphenyl-formyl-diamine. As soon, however, as an attempt was made to liberate a base, the compound was decomposed with evolution of ammonia and formation of an acetate, thus,—

$$\left.\begin{matrix}(C_2H_3)'''\\ H\\ H\\ H\end{matrix}\right\} N_2 + 2H_2O = C_2H_4O_2 + 2NH_3.$$

The Secretary read a brief note from Dr. Hermann Kolbe, referring to the conversion of malic acid into malonic acid, and propionic acid into succinic acid.

Dr. Hugo Muller gave a detailed account of some experiments he had been making in the same direction. Wishing to substitute cyanogen for chlorine in chloracetic ether, he had placed that substance in contact with cyanide of silver, but they did not react; he had been, however, partially successful in repeating the experiment with the iod-acetate of ethyl, and had formed in this manner cyano-acetic ether. The cyanide of mercury did not act upon chloracetic ether, but an alcoholic solution of cyanide of potassium formed immediately the alkaline chloride, and by evaporating the solution a product having a high boiling point was obtained, from which alcoholic potash disengaged ammonia, and by adding acetic acid and then lime to the solution the difficultly soluble malonate of calcium was precipitated. In like manner the speaker had succeeded in transforming chloro-propionic acid into succinic acid. The analyses were not completed, but there was no difficulty in recognising succinic acid as having been formed by this process, for it gave off on heating the characteristic cough-provoking vapours, and furnished the usual precipitate with perchloride of iron. The reaction must, therefore, be as follows:—

$$C_3H_5ClO_2 + K_2CN + 2H_2O = K_2Cl + NH_3 + C_4H_6O_4.$$

The President trusted that Dr. Müller would draw up an account of his experiments, so that these independent observations might be published simultaneously.

In reply to the President's inquiry, Dr. Muller stated that the malonic acid produced in this manner was not isomeric, but identical with that prepared from other sources. It crystallised, but the properties were not well known; such was, in fact, the reason of his delaying the publication of these researches, for he was desirous of studying more fully the chemical characters of the acid in question.

The Secretary then read a paper "*On a New Class of Organic Sulphur Compounds*," by Baron Oefele, student in Professor Kolbe's laboratory. (The formulæ of the substances named in the author's communication were given on the older plan, C = 6, which gave rise to some diversion, as Dr. Odling proceeded unwillingly to write them on the board.) The author had described in Liebig's *Annalen*, 1863, the action of oxygen in converting the mono-sulphide of ethyl into diethyl-sulphone thus—

$$\left.\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right\} S_2 \text{ became } \left.\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right\} S_2O_4.$$

The constitution of sulpho-benzide and propione were similar—

$$\left.\begin{matrix}C_{12}H_5\\ C_{12}H_5\end{matrix}\right\} S_2O_4. \qquad \left.\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right\} C_2O_2.$$

The fact which the author had now to communicate was the possibility of forming a direct combination of the mono-sulphide of ethyl with iodide of ethyl, which body, under the influence of nitrate of silver, gave a salt of triethyl-sulphyl, and with oxide of silver the hydrated base—

$$\left.\begin{matrix}C_4H_5\\ C_4H_5\end{matrix}\right\} S_2 + C_4H_5I = \left.\begin{matrix}C_4H_5\\ C_4H_5\\ C_4H_5\end{matrix}\right\} S_2I.$$

The composition of the platinum salt was as follows:—

$$\left.\begin{matrix}C_4H_5\\ C_4H_5\\ C_4H_5\end{matrix}\right\} S_2Cl,PtCl_2.$$

The President then invited Dr. Hofmann to favour the Society with an account of some agricultural results which he had engaged to communicate on the part of M. George Ville.

Dr. A. W. Hofmann stated that he had lately received from M. Ville an interesting account of some experiments which were made for the purpose of ascertaining how far the condition in which an element occurs influences vegetation. In other words, the author had endeavoured to ascertain the best form in which phosphorus, nitrogen, and other elements could be applied as manure to support the growth of plants. The results obtained, which in some instances were very remarkable, were indicated by the stature and development of the plants grown under these varying circumstances, and were made available for inspection and comparison by means of a very beautiful series of photographs of the actual plants, executed upon an uniform scale of dimensions. Proceeding to the examples, the author had taken, for instance, bone phosphate, phosphite of lime, and hypophosphite of lime, each in the proportion of equal weights of phosphorus contained in the salt. These had been separately mixed with ignited sand, and an amount of nitrate of potash corresponding to 0·11 gramme of nitrogen, and in earthen pots filled with such artificial soils the grains of wheat were sown. On reference to the photographs (three mounted on one card), it could easily be seen that the common bone phosphate far outstripped the others, and these latter exhibited a difference in favour of the phosphite. The wheat plants weighed (in grammes) as follows :—

	Straw and Roots.	Grains of Corn.
Phosphate of lime . .	17·	4·
Phosphite of lime . .	3·	0·2
Hypophosphite of lime .	1·	none.

Similar experiments, in which the nitrate and nitrite of potash were compared as before with wheat, the amount of nitrogen in the salts remaining 0·11 gramme, gave results in favour of the common saltpetre ; thus :—

WHEAT.

	Straw and Roots.	Grains.
Nitrate of potash . .	16·	6·
Nitrite of potash . .	4·	1·

BUCKWHEAT.

	Straw and Roots.	Grains.
Nitrate of potash . .	8·	3·
Nitrite of potash . .	3·	1·

COLZA.

Nitrate of potash . .	5 grms.	(entire plant.)
Nitrite of potash . .	2 ,,	do.

Using nitrogenous manures in the form of salts of ammonia, ethylamine, and methylamine, they were found to be practically identical in the cases of wheat, barley, and buckwheat ; but colza grown with sal-ammoniac, chloride of ethylammonium, and chloride of tetrethylammonium, showed results greatly in favour of the common ammonia, and the last-named salt proved almost useless. Colza grew well with ordinary urea, but could not be raised with ethyl-urea. Again, the cyanate of potash did not answer nearly so well as urea. From a consideration of this circumstance, the author was inclined to state the following as being the "vegeto-formula" of urea, viz. :—

$$\left.\begin{matrix}CO\\H_2\\H_2\end{matrix}\right\}N_2.$$

The author had, finally, compared urea with oxalate of ammonia and oxamide, and found their efficiency to be in this order.

The PRESIDENT considered the Society must feel greatly indebted to M. Ville for a communication of such interest, and which was, moreover, so well illustrated by means of photography, and to Dr. Hofmann, also, for the able manner in which he had laid before them these results, the original account of which was written in a foreign language. With regard to the experiments with hypophosphite of calcium and cyanate of potassium, he thought the conclusions a little open to criticism, for in these cases decompositions would occur, and the effects be ascribed to a wrong cause. The cyanate would, in fact, soon be converted into the carbonates of ammonia and potash.

Dr. HOFMANN was grieved to find that the oxide of tetrethylammonium had not realised the expectations which the admirers of this compound had formed of it. There seemed, however, one point conclusively established in these trials—viz., that this base was a kind of potash, and, not being decomposed, could not furnish the nitrogen required for the growth of the plant.

Dr. DE LA RUE inquired whether there was any reference to the use of nitrate of ammonia in the author's paper ? (No mention was made of this salt.)

Dr. GILBERT had made trial with nine acres of wheat of nitrates in comparison with ammonia, and found that, by employing them in equivalent proportions, their action was identical.

Dr. VOELCKER took objection to the plan upon which the author had been working. He conceived that, instead of investigating the action of the compound ammonias and other bodies that were never likely to be employed in agriculture, there would have been great advantage in attacking first some of the simpler problems, and giving, in this way, a more practical turn to the whole question.

Dr. HOFMANN could not altogether agree with the last speaker. He thought the "cui bono" had been lately so often and well answered in this Society, that it might now be fairly assumed to be finally uttered. Aniline and the compound ammonias were not likely to be used in the place of farm-yard manure ; but he conceived it to be perfectly legitimate to examine whether these substances could be assimilated with plants. He was much impressed with the good maxim taught, more than a hundred years ago, by Boerhave, to the effect that "all created things are useful ;" and he concluded by quoting an amusing passage from Boerhave's lectures, in which the distinguished chemist expresses his opinion of the usefulness of phosphorus in his time.

The PRESIDENT then announced the programme relative to the changes in the Council, which would be proposed for adoption at the anniversary meeting on March 30. The name of Dr. Stenhouse was to be substituted for that of Dr. H. Bence Jones, who retires from the vice-presidency ; and the new members of Council were to be Dr. Maxwell Simpson, Mr. Dugald Campbell, Mr. Way, and Mr. Nicholson.

The meeting of the Society was then adjourned until March 3, when a paper "*On the Non-Metallic Impurities of Commercial Copper,*" by the Chemist of the War Department, would be read.

NOTICES OF BOOKS.

International Exhibition : Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. HOFMANN, F.R.S., LL.D., &c., &c.

(THIRTEENTH NOTICE.)

(*Continued from page* 95.)

THE part of this Report relating to the coal tar dyes is one of the most interesting in the book. Those of our readers who visited the Exhibition do not need to have recalled to their minds the superb and brilliant displays in the eastern annexe ; and to those who had not the good fortune to see the Exhibition, any description would fail to depict those "crimsons of the most gorgeous intensity, the purples of more than Tyrian magnificence, and blues ranging from light azure to the deepest cobalt ;" and "contrasted with these, the most delicate roseate hues, shading by imperceptible gradations to the softest tints of violet and mauve." Added to these was the magnificent appearance of the crystallised dyes themselves, which will not soon be forgotten by those who saw them before their lustre had been dimmed by time and exposure. And all these had "the same prime origin," viz , the noisome tar which stood, in ugly contrast, beside them.

Before addressing himself to the chemistry of their metamorphosis, the author offers some remarks on the economical bearings of the subject, and its probable commercial consequences. These are already of some importance; but the author looks forward to a not far distant day when "this infant industry will enable us to match exactly, with its coal-derived equivalent, each of the various tones of colour previously derivable only from costly vegetal and animal sources, such as tinctorial insects, barks, roots, and flowers." How the murexide crimson from uric has been obtained from picric acid (a coal derivative) we have lately shown, and this is probably only one of a long series of similar triumphs, which may have a most important influence on the industrial fortunes of Great Britain.

"For if coal be destined sooner or later to supersede, as the primary source of colour, all the costly dye-woods hitherto consumed in the ornamentation of textile fabrics—if this singular chemical revolution, so far from being at all remote, is at this moment in the very act and progress of gradual accomplishment—are we not on the eve of profound modifications in the commercial relations between the great colour-consuming and colour-producing regions of the globe? Eventualities, which it would be presumptuous to predict as certain, it may be permissible and prudent to forecast as probable; and there is fair reason to believe it probable that, before the period for another decennial exhibition shall arrive, England will have learned to depend, for the materials of the colour she so largely employs, mainly, if not wholly, on her own fossil stores. Indeed, to the chemical mind it cannot be doubtful that in the coal beneath her feet lie waiting to be drawn forth, even as the statue lies waiting in the quarry, the fossil equivalents of the long series of costly dye materials for which she has hitherto remained the tributary of fossil climes. Instead of disbursing her annual millions for these substances, England will, beyond all question, at no distant day, become herself the great colour-producing country in the world; nay, by strangest of revolutions, she may, ere long, send her coal-derived blues to indigo-growing India, her tar-distilled crimson to cochineal-producing Mexico, and her fossil substitutes for quercitron and safflower to China, Japan, and the other countries whence these articles are now derived."

The last of these prophecies is already accomplished. We export large quantities of aniline red to China, and the importation of safflower has considerably diminished. How largely the trade in cochineal has been influenced may be seen from our Custom House returns, published within the last few days:—

"In the year ended December 31, 1862, the quantity of cochineal imported into this country was 22,760 cwts. Compared with the returns for 1861, a falling-off is apparent of 7253 cwts., notwithstanding which there is a declension in price, and which has continued since the year 1858 (the year in which aniline red was first produced), when the range was from 21*l.* 7s. 10d. to 21*l.* 14s. 11d. per cwt; whereas in 1862 it was only from 13*l.* 8s. 7d. to 14*l.* 18s. 6d. per cwt."

Diminished imports and declining prices tell their tale of absence of demand.

We have not space here for the complete list of the substances obtained by the distillation of coal, but will find room shortly, since it may prove interesting to some of our readers to whom this report is not accessible.

The history of aniline and benzole, and the transformation of the one into the other, has been already told more than once in our pages, so we shall not stop to recount it again, but pass on at once to the coloured derivatives. The account of aniline violet offers but little of novelty. Our readers must be well acquainted with the various processes patented for its production, not many of which, however, are practically employed. The great objection, which, indeed, applies at present to all, is the very small quantity of aniline converted into colouring matter. "When we consider," says the Report, "that from one hundred parts of aniline not more than four or five parts of violet can at present be prepared, all the rest being converted into comparatively worthless tarry products; and, moreover, that the present process must always be carried out on a comparatively small scale, we cannot help thinking that the really rational and convenient mode of transforming aniline into mauve still remains to be devised."

One novelty we meet with here is the *violet impériale* of Girard and De Laire. It is made by heating equal quantities of dry hydrochlorate of rosaniline and of aniline to a temperature of 180° C. If not more than four kilogrammes of the mixture are heated at a time, the operation is complete in about four hours. This colour is considerably employed in dyeing and printing. It rivals mauve in beauty, but is less fast. Its composition is unknown. Mr. Nicholson has obtained a similar violet by carefully heating aniline red in a suitable apparatus to a temperature between 200° and 215° C., whereby the red substance is transformed into a dark substance, with evolution of ammonia. The dye is dissolved out of the mass with acetic acid.

The account of aniline red is of considerable length, and we defer it until next week.

Tables of Chemical Formulæ. Arranged by W. ODLING, M.B., F.R.S., &c. &c. London: Taylor and Francis. 1864.

THIS is a very useful compilation, which would have been made still more useful if it had been prefaced by a short introduction giving an account of the systems adopted by the author. The first table, for example, requires, for ordinary students, an explanation of the term "Perissad," which Dr. Odling applies to a certain class of elements. They are, in fact, those which combine with 1, 3, 5, and 7 (all odd numbers) of chlorine; and so, perhaps, these elements may be very appropriately called "Perissads" (περισσος, an odd number), as opposed to another class which combine with 2, 4, and 6 of chlorine, and here denominated "Artiads" (αρτιος, even). There is a third class, iron, manganese, &c., which combine with both odd and even numbers, and are called "Periss-artiads."

Even without these explanations, however, the tables will be found extremely useful to both teachers and students. They comprise tables of the atomic weights and symbols of the elements, carefully classed and grouped, a table of illustrative simple oxides, atomic heat, equivalent notation, vapour densities, normal and anomalous, and many others which exhibit great industry and ingenuity on the part of the compiler.

We strongly recommend a study of the tables to all who wish to master the difficulties of modern chemical notation.

NOTICES OF PATENTS.

2853. *Obtaining Fresh Water by Evaporation.* A. CHAPLIN and G. RUSSELL. Glasgow. Dated October 23, 1862.

WITH the object of more effectually aërating the water obtained by distillation, and thereby improving its flavour, the inventors direct a jet of steam, under considerable pressure, into the condensing apparatus, and allow it to serve as an aspirator in drawing in a current of air, which, freely surrounding the aqueous particles at the moment of condensation, are more quickly absorbed.

2856. *Treating Alkali Waste to Obtain Sulphur therefrom.* EDWARD BATH, Swansea. Dated October 23, 1862. (Not proceeded with.)

THE object of this invention is the recovery of sulphur from the refuse oxysulphides obtained in the alkali manufacture, and, at the same time, to economise the sulphur which, in the form of sulphurous acid, is poured into the atmosphere of Swansea from the chimneys of the copper smelting works. The principle on which the process of recovery is based is that involved in the mutual decomposition of sulphurous acid gas and sulphuretted hydrogen, which, when brought into contact, give rise to the formation of water and precipitation of the whole of the sulphur. The operation is carried out by erecting a tower or shaft filled with smooth pebbles, over and through which a slow stream of water is allowed to descend; connected with the bottom of this tower is an apparatus wherein the alkali waste is treated with crude muriatic acid, and the sulphuretted hydrogen so generated is allowed to escape into the shaft, which is at the same time freely open to receive the sulphurous gas disengaged from the furnaces in which copper ores are undergoing calcination. The proportions of the two gases admitted should be so regulated that neither should greatly preponderate; under these circumstances the process may be made continuous, the escaping water furnishing an index of the proper working of the stack, for in the event of one gas being in excess it will be immediately manifested by the smell of the water.

A process such as the above would be invaluable if means could be devised for establishing and maintaining a powerful current of air through the entire arrangement, so as not to interfere at all with the proper action of the calcining furnaces. It would be important also to find an application for the chloride of calcium formed as the secondary product.

Grants of Provisional Protection for Six Months.

10. Jean Louis Prosper Duroy, Faubourg Montmartre, Paris, "An improved method of manufacturing soap with a vegetable basis."—Petition recorded January 2, 1864.

58. Bernhard Samuelson, Banbury, Oxford, "An improvement in smelting iron ore."

66. James Gibbins, Lawn Villas, South Lambeth, Surrey, "Manufacturing a composition which will render railway and other tarpaulins, rick cloths, waggon covers, gig, omnibus, and all other carriage aprons and covers, whether composed of canvass, leather, or other material, perfectly waterproof and non-combustible."

80. William Clark, Chancery Lane, London, "Improvements in the means of obtaining or preparing fibrous material from vegetable matters."—A communication from Hubert Dupré, Boulevart St. Martin, Paris.

3131. Ernest Solvay, Brussels, Belgium, "Apparatus by means of which the formation of carbonates of soda by direct combination is rendered practically available for manufacturing purposes."—Petition recorded December 11, 1863.

5. William Clark, Chancery Lane, London, "Improvements in the manufacture of chlorine."—A communication from Francois Marie Aubert de Tregomain, Boulevart St. Martin, Paris.—Petitions recorded January 1, 1864.

109. John Edward Baker, Birmingham, "Improvements in retorts and furnaces for distilling coal and other solid hydro-carbons, for the manufacture of volatile oils therefrom, which improvements may also be applied to retorts and furnaces used for other purposes."

120. David Auguste Burr, Southampton Buildings, Chancery-lane, London, "Improvements in lightning arresters for protecting electric telegraph apparatus."—A communication from George Stearns, Rochester, New York, U.S.

125. Jacob Jehoshaphat Salter Mountain, St. Heliers, Jersey, "New or improved means of obtaining motive power, by the combination of steam power with atmospheric or hydraulic pressure, or with both."

131. Carl Vogt, Cassel, Hesse, "Improvements in the manufacture of pigments."—A communication from Ludwig Schad, Cassel, Hesse.

152. Thomas Lightfoot and John Lightfoot, Accrington, Lancashire, and George Powell Barnes, Manchester, "Improvements in fixing colours on woven fabrics or fibrous materials."

163. Edgar Townend Jarrold, Norwich, Norfolk, and George John Yates, Penketh, near Warrington, Lancashire, "Improvements in deodorising paraffin, petroleum, rock, shale, and other hydrocarbon oils."

203. William Ibotson, Wraysbury, Buckinghamshire, "An improvement in the process of bleaching materials for paper making."

225. John Henry Johnson, Lincoln's Inn Fields, London, "Improvement in stopping bottles containing aërated liquids."—A communication from Edward Hamilton, Chicago, U.S.—Petitions recorded January 26, 1864.

Notices to Proceed.

2371. William Clark, Chancery Lane, London, "An improved fabric for the production of permanent electricity, applicable for wearing apparel."—A communication from Theodore Courant, Boulevart St. Martin, Paris.—Petition recorded September 26, 1863.

MISCELLANEOUS.

Patent Laws.—At the annual meeting of the Association of Chambers of Commerce, held on Tuesday last, Mr. Wright moved, "That the granting of patents for improvements and discoveries in manufactures is right in principle, and has been found beneficial in operation." Colonel Akroyd seconded the motion; and, after an amendment to the effect that the patent laws ought to be abolished had been negatived, the original motion was carried.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

J. N.—The crystals are sulphate of lime. Your solution was not made with distilled water.

Photo.—We shall have a paper on the manufacture of bromides shortly.

D. Z.—Our correspondent is no doubt right as to the absence of novelty in the patent.

W. B.—We cannot give the information. A patent agent will supply it.

Mr. Geldard is thanked for his communication. 1. Acetate of soda is added to ensure the precipitation of all the iron. 2. "Peroxidises" was of course a clerical error for "oxidises," overlooked. It is the hydrogen of the hydrochloric acid which is oxidised in the solution —not the iron.

A Correspondent has copied the following receipt from a patent dated September 7, 1860, and wishes to know how the ingredients can be combined so as to form the "impermeable oil varnish which possesses the advantage of being impervious to water, of rendering the object varnished extremely pliable, and of giving it a brilliant polish," as promised in the specification:

100 parts	Alcohol.
100 ,,	Spirits of turpentine.
1 ,,	Sulphuric ether.
1 ,,	Carbonate of soda.

We must frankly confess our inability to give our correspondent the information he asks, and recommend him to write to M. Antoine Bovet, of Paris, who alone can possess the valuable secret. What the chemist sent was exactly what we should have expected to see.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Calabar Bean, by J. Jobst *and* O. Hesse.

The physiological properties of the Calabar bean have been well studied in this country, but the authors above named are, we believe, the first who have isolated the alkaloid to which it owes its activity, and to which they have given the name *Phytostigmine*.

The poison is found only in the cotyledon, and is extracted in the following way:—The decorticated beans, well pulverised, are exhausted by repeated treatment with boiling alcohol (80 per cent.). On cooling, the alcoholic solution becomes slightly turbid, and on evaporation yields a yellowish residue, which gives a cloudy solution with water, from the separation of some oil. Calcined magnesia is now added to the aqueous solution until no acid reaction is exhibited, and a brown colour is produced; the mixture is then evaporated by a gentle heat. While still moist, the residue is repeatedly shaken up with ether until all the brown colour is removed. The mixed ethers are then filtered, and a few drops of dilute sulphuric acid are added. In this way two layers are obtained; the upper consisting of an etherial solution of oil and other inactive ingredients of the bean, and the lower of an aqueous solution of sulphate of phytostigmine. The latter, carefully separated from the ether, may be again precipitated by magnesia, and the alkaloid extracted with ether; and lastly, the etherial solution evaporated.

In this way phytostigmin is obtained as a brownish-yellow amorphous mass, which first separates in oily drops, easily soluble in alkalies, ether, benzol, and alcohol, and slightly soluble in cold water. The alkaloid is completely separated from the etherial solution by animal charcoal. The aqueous solution has a slightly acrid taste, and a decidedly alkaline reaction. With biniodide of potassium it gives a rich kermes-coloured precipitate; and from perchloride of iron it throws down the hydrated peroxide of iron. Fused with potash, the alkaloid gives off strongly alkaline vapours. Acids dissolve it easily, giving for the most part dark red, and less often dark blue salt solutions, which are more or less decolorised by sulphuretted hydrogen.

The hydrochlorate, sulphate, and acetate, have been obtained as a red amorphous masses, easily soluble in alcohol and water. The hydrochlorate gives the following reactions:—

With *tannic acid*, a considerable reddish-white amorphous flocculent precipitate; difficultly soluble in hydrochloric acid.

With *chloride of platinum*, a pale yellow amorphous precipitate; easily soluble in hydrochloric acid and boiling water.

Chloride of gold gives a bluish precipitate. After a short time gold separates, and the solution becomes purple red.

Chloride of mercury produces a reddish-white precipitate; easily soluble in hydrochloric acid; insoluble in the chloride of mercury.

The quantity of phytostigmine obtained by the authors was insufficient for a complete analysis. Their experiments leave no doubt that the alkaloid is the active principle of the bean.

One curious fact observed by them was, that the poison produces contraction of the pupil when applied to recently dead animals. They placed two drops of the aqueous solution of the alkaloid in one eye of a rabbit which had been dead (not poisoned) an hour, and, in consequence, the pupil of this eye contracted to one-fourth (compared with the other eye), and remained in this condition.

TECHNICAL CHEMISTRY.

Arguments for and against Prolonged Vatting in the Fabrication of Wine—Alcoholic Fermentation during the Process, by M. A. Béchamp.

Vatting may be defined as—leaving the wine for a longer or shorter time on the skins, or on both the skins and stalks of the grapes.

Experience has taught me that prolonged vatting is never injurious; on the contrary, very perfect wines are obtained in this way, if one condition be attended to—carefully to avoid contact with the air.

Both old and recent writers insist strongly on the necessity of immediate removal from the vat, that is to say, "as soon as the first subsidence of the head becomes apparent, or when the fermentation, having attained its maximum, begins to decrease."

Whilst the fermentation is active, the whole of the contents of the tun is impregnated with carbonic acid, and the tun itself is filled with it. During this time, the stirred-up residuum (the head), the froth, and the wine are preserved from the influence of the air, and the still more pernicious influence of the germs brought by it. If, then, the wine is unvatted as soon as the head begins to subside, or as soon as the fermentation ceases to be active, it will evidently escape the influence of the germs which may be developed in the head. There is, no other reason for premature removal from the vat though, in my opinion, the cause of this absolute necessity has not been sufficiently inquired into.

But is it clearly proved that mouldiness is developed in the head and froth as soon as the fermentation becomes less active? This is the fact, and an annoying one, too.

During the autumn of 1862 I assured myself of the formation of this mouldiness. One of my fermentations was effected with the same grape as that which had served in former experiments (in which the fermentation took place sheltered from the air), but in which the air had had access through a very small aperture. The vatting was not very prolonged, and I ascertained the presence of mouldiness in nearly the whole depth of the stirred-up residuum. The wine thus obtained was not at all good, and would not keep. It was less alcoholic, and contained more extractive matters than wines I made with the air excluded; those were excellent; they kept well, and improved by keeping, and yet the vatting lasted from one to three months. It may, perhaps, be supposed that this method will not serve in wine-making on a large scale. This is an error. Under conditions much more unfavourable, as the fermentation subsides, mould is developed, and this development corresponds to the relative height of the temperature of the tun or vat, so that its effect should be much more detrimental than was the case in my experiment, in which the temperature was less high.

I had an opportunity of verifying this fact during this year's vintage. In some fermentations of 21,000 and 28,000 litres, not a single tun did I see in which the head, at the seventh day, was not impregnated with various kinds of mould of globuliform ferments, differing from the yeast of beer, and from the many ferments of different forms understood by the term *filiform*, which I last year observed in my laboratory fermentations.

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* Abstract from *Annalen der Chem. und Pharm.*, Bd. cxxix., s. 115.

The same holds good with the scum of tuns wherein white wine has been made. As soon as the air enters freely into the tuns, which is inevitably the case when the quantity of carbonic acid is no longer large enough to successfully oppose its entrance, it becomes charged with these little organisms.

The rapid formation of these productions has been regarded as sufficient reason for quickly unvatting; and herein we find the explanation of the practice bequeathed to us from the observation and experience of our forefathers.

The immediate consequence is, that if we wish to avoid the influence of these organisms, we must unvat before their development, that is to say, before the active fermentation is at an end. We should thus fall into the opposite extreme, and all extremes are bad.

From my point of view the following disadvantages arise from prolonged vatting:—I have remarked that in fermentations to which the air had access, the head quickly becomes pale, while the flavour of the residuum is disagreeable, and not altogether vinous. This condition augments until the whole of the head becomes musty, which speedily takes place on account of its porosity. Two days after the cessation of the tumultuous fermentation, the stirred-up residuum is musty to the depth of more than a decimetre. The wine may thus become tainted, and, as the head is porous, the vatting, however managed, takes with the wine, besides the mould, the altered matters of the head. Hence, I believe, the disagreeable flavour of wines obtained in this way—the roughness and earthy taste, which are absent in wines made with the air excluded.

For the rest I have advanced nothing which I cannot verify. In wines unvatted at the eighth day, especially in pressed wines, even in those fermented in tuns sufficiently closed to prevent the free access of the air, I ascertained the presence of myriads of ferments of various forms.

From all this, it results that, to avoid the access of air, it is necessary to unvat as speedily as possible, at the risk of obtaining incompletely fermented products, and so—according to M. Dumas—to finish the ferment in full tuns, as in champagne.

My observations have suggested to me the following means for facilitating more prolonged vatting. It will doubtless be long before the present method undergoes any alteration, since it is founded on principles different to those I put forward. To keep the head from contact with the air, and to fulfil the conditions similar to those of fermentations in closed vessels, the following is, I believe, the best mode of proceeding:—

Immerse the head by pouring some of the wine on it; before the fermentation abates, fill the vat up to the bung; close carefully, so that only a very small portion of scum may be exposed to the air. For this purpose the wine may be drawn from a neighbouring vat while the fermentation is still active, or on the point of ceasing to be so. For this purpose a tun or vat should be provided for each kind of wine, and as soon as it becomes empty, the residuum should be pressed and divided among the tuns, where the fermentation is finished with almost absolute exclusion of air. The combination of this method with those I have proposed in my six recent studies on alcoholic fermentation during wine-making, seems to resolve the question in a manner which, if not the best, is at least the most economical. Some of these facts appear to me to be new, and some forgotten; they are condensed in the following conclusions:—

1. Cane sugar is not a sugar, for it possesses neither the property of fermenting directly, nor of reducing M. Barreswil's reagent. Like dextrine it combines with the elements of water, and is converted into glucose, under the influence of acids or of a ferment.

2. Some time ago I showed that the glucosic ferment of cane sugar is spontaneously developed by the germination of the germs brought by the air in solutions of this body; thus proving that cane sugar may be transformed into glucose by other means than by acids.

3. Beer yeast, by itself, serving as a must in the first moment of its action on cane sugar, behaves like a double compound ferment, analogous to cane sugar.

4. Ferments are formed from germs in the air in a medium wherein sugar and albuminoid matter coexist. This is the result of my investigations on the development of mould in sugared water, and their subsequent action on cane-sugar.

5. Following M. Dumas' suggestion, I admit that the ferment is an organised being, existing and nourished in the same manner as animals.

6. Alcoholic fermentation by the influence of the ferment on sugared water, without the addition of an albuminoid matter in a suitable state, is an abnormal action; for the organised being cannot then normally develop, be nourished, and multiply.

7. During fermentation in a simply sugared medium, the globules multiply and increase only by supporting themselves on the materials furnished by their predecessors. Thus, the ferment, whilst multiplying itself, gives, in absolute weight, less product than was employed in the first instance. I speak, of course, of fermentations not too prolonged, and for which a sufficient quantity of leaven has been used.

8. According to M. Dumas, the fermentation is not complete unless the ferment is properly maintained.

9. During the physiological process involved in the life of a ferment in the fermentable medium, disengagement of heat takes place. The elevation of the temperature is in proportion to the fermenting mass the quantity of ferment (that is to say, the number of individuals which consume), and to the original temperature of the mixture and of the surrounding medium. This, to me, seems a consequence of the nature, rather animal than vegetable, of the cellule of the ferment.

10. In the most physiological conditions of the fermentation, there is necessarily a formation of acetic and other volatile acids.

11. If volatile acids are formed during the alcoholic fermentation, the odoriferous ethers of these acids ought to be developed, and are so, in fact, under all circumstances.

12. The formation of ferment in the must of grapes has a two-fold result. The ferment eliminates, by rendering insoluble, the albuminoid matter of the grape, and transforms the sugar as well as the other materials of the must.

13. Wine normally and duly made contains no properly so-called albuminoid matter.

14. In the fermentation of grape juice, the sugar is not always completely transformed, because the medium becomes too complex. It has been ascertained by an experiment, that sugar is integrally transformed only when the must contains hardly more than 200 grammes per litre; and during the fermentation of wort the sugar furnishes more alcohol and less carbonic acid than is required by theory.

15. Chaptal says that Le Gentil and Poitevin mention the elevation of the temperature during the fermentation of the grape; it rises in proportion to the heat of the

place in which the wine is made, and the largeness of the mass fermented. It must be borne in mind that great inconvenience attends too copious a disengagement of heat during vinous fermentation.

16. The considerable disengagement of heat augments the volume of carbonic acid, and entails the loss of alcohol and etherised volatile compounds formed during the fermentation, and which contribute to form the bouquet of wine.

17. I have proved the formation of etherised compounds with fruity odours during vinous fermentation; likewise during artificial fermentation, and that as a consequence of the formation of volatile acids.

18. The development of heat diminishing in proportion to the smallness of the bulk fermented, and the lowness of the temperature, it follows that the mass fermented should not be too large.

19. I have advised prolonged vatting; but to render this advantageous, all contact with air should be avoided.

20. I have described the detrimental influence of the air, and the formation of mouldiness in the head, formed by the stirred-up residuum in tuns where fermentation is effected with the skins or with both skins and stalks; and to this mouldiness I attribute the alteration in the materials of these residuums, and afterwards in the wine itself. Through the porosity of the head and the mould, oxygen is readily absorbed, and the residuum acetified.

21. M. Dumas long ago indicated the spontaneous production of whitish mucors in wines as a cause of their rapid deterioration.—*Comptes Rendus*, lvii., 674. 63.

Theoretical Researches on the Preparation of Soda by Leblanc's Process, by M. A. Scheurer-Kestner.

Oxysulphide of Calcium.—The absence of any definite reaction between the insoluble sulphuretted part of rough soda and solutions of carbonate of soda has led M. Dumas to admit the existence of a compound of sulphide and oxide of calcium, supposed to be insoluble in water.

But sulphide of calcium is itself very little soluble in water; from experiments made with the greatest care it results that water at 12° C., dissolves only $\frac{1}{12500}$th of this body, prepared by calcining sulphate of calcium with charcoal. The sulphide of calcium was previously washed with alcohol, to eliminate the small quantities of polysulphides which it nearly always contains.

Pure sulphide of calcium put in contact with solutions of carbonate of sodium gradually transforms this salt into sulphide; but double decomposition between the two salts is very slow.

By treating with water simultaneously and under the same conditions, powdered rough soda and a mixture in given proportions of carbonate of sodium and sulphide of calcium, the solutions at the end of an equal length of time contained the same quantities of sulphide of sodium.

The hypothesis of the existence of insoluble oxysulphide of calcium is, then, not necessary to account for the inertness of residuums in solutions of rough soda. Moreover, the result is the same from leaving rough soda long in contact with water. The solution thus obtained is more charged with sulphide of sodium, but the insoluble residuums no longer contain oxide of calcium. By estimating the calcium, sulphur, and carbonic acid in it, we shall find that we have to deal only with a mixture of carbonate and sulphide of calcium.

In this case, also, it is observed that the causticity of the liquids considerably increases; the carbonate of sodium being decomposed by the hydrate of calcium gradually formed by the oxide. Were the oxide of calcium combined with the sulphide to form oxysulphide, the sulphide of sodium would increase in the liquids in proportion to the caustic soda, but experiment shows the contrary.

Caustic Soda contained in Solutions.—The presence of caustic soda in solutions of rough soda led to the supposition that this body exists in the product before undergoing the action of water—a necessary consequence this of the hypothesis of oxysulphide of calcium. From the fact that alcohol does not dissolve caustic soda when digested with rough soda, M. Gossage concludes that this body is formed during the solution in water, and hence he denies the existence of oxysulphide. To obviate this difficulty M. Kynaston admits the formation of an insoluble compound of sulphide and carbonate of calcium, formed by the action of the water, simultaneously with caustic soda. But the absence of caustic soda in alcohol only proves that rough soda is free from hydrate of sodium, while it may contain anhydrous oxide of sodium, a body insoluble in alcohol.

As it is proved that oxysulphide of calcium does not exist, it may be admitted that caustic soda forms only during the action of water; this is, in fact, shown in estimating the carbonic acid contained in rough soda; the quantity of this acid found in it is always greater than is necessary for the saturation of the sodium. A portion of the limestone even remains intact. The partial decomposition of the excess of limestone employed in the preparation of rough soda accounts for the variations in causticity observed in liquids obtained with soda by different operations. An evident proof of the formation of caustic soda during solution in water is, that the water carries off from the rough soda itself the whole of the sodium and variable proportions of caustic soda, depending only on the duration of the contact of the insoluble residuums with the solution.

Origin of Soluble Sulphides.—MM. Gossage and Kynaston are of opinion that the soluble sulphides contained in solutions of rough soda pre-exist in this product in the state of polysulphide of calcium, and that by simply avoiding the formation of these polysulphides while preparing the soda, pure liquids are to be obtained. But these polysulphides should dissolve in alcohol, while well-made rough soda yields to this liquid only traces (0·005 to 0·006 per 100 parts of rough soda) of monosulphide of sodium in quantity much less than is to be found afterwards in solutions of this same soda washed in alcohol.

The sulphide of sodium contained in solutions of rough soda are derived chiefly from a partial double decomposition which takes place between the dissolved sulphide of calcium and carbonate of sodium. Polysulphides exist in rough soda which has been subjected to too high a temperature, not as salts of calcium, but as salts of sodium. Sodium and sulphur are present in proportions corresponding to the disulphide of sodium, as may be seen by analysing the alcoholic solution of this soda. Disulphide of sodium is formed by the reduction at a high temperature of carbonate of sodium on sulphide of calcium, according to the following equation:—

$$\underbrace{2\mathrm{Ca_2S}}_{\substack{\text{Sulphide}\\\text{of calcium.}}} + \underbrace{\mathrm{Na_2}\cancel{\mathrm{C}}\cancel{\mathrm{O}}_3}_{\substack{\text{Carbonate}\\\text{of sodium.}}} = \underbrace{\mathrm{Na_2S_2}}_{\substack{\text{Disulphide}\\\text{of sodium.}}} + \underbrace{\cancel{\mathrm{C}}\cancel{\mathrm{O}}}_{\substack{\text{Oxide}\\\text{of carbon.}}} + \underbrace{2\mathrm{Ca_2}\cancel{\mathrm{O}}}_{\substack{\text{Oxide}\\\text{of calcium.}}}.$$

Rough soda containing disulphide of sodium produces solutions containing a large quantity of caustic soda. The excess of caustic soda is produced by the oxide of calcium formed simultaneously with the disulphide of sodium. Moreover, it happens often that soda which has undergone too high a temperature contains oxide of sodium formed by the reduction of carbonate by charcoal.

Thus the hypothetical existence of oxysulphide of calcium is not necessary to explain the small degree of reaction which takes place between solutions of rough soda and insoluble residue. This residue is formed by a mixture of carbonate and sulphide, or of carbonate, oxide, and sulphide of calcium. The caustic soda contained in solutions of rough soda is formed by the action of the hydrate of calcium of the insoluble residues on carbonate of sodium; but when rough soda has been brought to a high temperature it may contain oxide of sodium formed by the reduction of the carbonate. Soluble sulphides are the product of a partial reaction between carbonate of sodium and sulphide of calcium in water. Moreover, rough soda which has been submitted to a high temperature contains polysulphides of sodium, but never polysulphides of calcium.

It remains to be determined which reaction effects the transformation of sulphate of sodium and chalk into sulphide of calcium and carbonate of sodium, and why it should be necessary to employ an excess of calcium, without which carbonate of sodium charged with sulphide is obtained.—*Comptes Rendus*, lvii., 1013.

PHARMACY, TOXICOLOGY, &c.

Tannin, its Employment as a Substitute for Cinchona.

UNDER this title, Dr. Leriche has published a memoir, which received a silver medal from the Society of Medical Sciences of Brussels.

The author arrives at the following conclusions:—

1. Pure tannic acid, properly administered, is an excellent anti-periodic.
2. It possesses real efficacy in the treatment of all intermittent fevers of a simple quotidian type.
3. The facility of its extraction, its low price, its innocuousness, render it preferable to sulphate of quinine, or at least to the other derivatives of cinchona.
4. It consequently unites all the qualities of a good succedaneum, and constitutes, at the present time, the best of indigenous febrifuges.—*Journ. de Chimie Médicale.*

On a New Kind of Cubebs.

WITHIN a brief period, cubebs from the Dutch East Indies have entered commerce; they are attributable to an analogous species, and are offered at a much lower price than ordinary cubebs. But they differ essentially from true cubebs, and must be considered as false and improper for medical employment. M. Pas, as well as M. Grœnewegan, have examined them. The size of this cubeb surpasses considerably that of black pepper, and is nearer that of allspice. Its colour is ash-grey, approaching brownish black, and the wrinkles on the surface are less deep and more regular than those of true cubebs; the petioles are a little flattened. The odour is less agreeable, and the taste less burning, less pungent, and more like mace.

Thrown into water, the new cubeb absorbs it more rapidly, and precipitates, consequently, much sooner than ordinary cubebs. It colours the water deep brown, whilst true cubebs gives it but a light yellow, after several days' contact. Maceration in water softens both fruit and seed, which is not the case with cubebs.

True cubebs are difficult to powder; the false drug is easily reduced to powder. The true powder is deep brown, of an aromatic odour, whilst its congenor is greyish-red, with a terebinthinate odour. The volatile oil of this berry possesses a sharp odour, resembling a mixture of flower of nutmegs, lemons, and oil of turpentine, and is colourless, whilst that of cubebs is thicker and greenish coloured.

A hundred parts of true cubebs yield twenty-one of a greenish balsamic extract to ether; whilst, in the same manner treated, the false drug gave but ten parts of a brownish balsamic extract. M. Pas thinks this drug is the ripe fruit of *Piper cubeba*, whilst M. Grœnewegan thinks they are the product of *Piper anisatum.—Journ. de Chim. Méd. et Journ. de Ph. d'Anvers.*

Note on Some Properties of Berberine,

by WILLIAM PROCTER, *Jr.*

HAVING occasion recently for information relative to the properties of pure berberine in an uncombined state, a reference to all the authorities at my disposal, including nearly all the papers published within the last few years, I noticed with some surprise that these writers, in describing berberine, treated the substance obtained from *Berberis vulgaris* by the agency of neutral solvents, and which, as berberine is an alkaloid, must be a natural salt of that substance.

Buchner, the original discoverer of this principle, believed it to be a neutral substance. Liebig (*Traité de Chemie*, tome ii., 645,) says it is alkaline, but in describing its preparation, gives the original process, and describes its solubility in the form of its natural salt, as requiring 500 parts of cold water. Wittstein, in his "Practical Pharmaceutical Chemistry," (Darby's translation), also describes it in this condition as obtained by neutral solvents, and gives the same numbers for solubility that Liebig does. He also says that this natural salt is the hydrochlorate, a statement I have not seen elsewhere. I have consulted the papers of Fleitman, of Stenhouse, and of Perrins, in the *Pharmaceutical Journal*, and those of Mahla and Merrill in the *American Journal of Pharmacy*, and none of them describe the properties of pure berberine.

The best process for isolating berberine is that hinted at by William A. Merrill (*Amer. Jour. Pharm.*, p. 503, 1862), based on the separation of the sulphuric acid from the sulphate by either baryta or oxide of lead. Mr. Merrill prefers the oxide of lead, and I agree with him, as, from its insolubility in water, its excess does not interfere with the purity of the resulting alkaloid in solution.

Take the root of *Hydrastis canadensis*, or of *Berberis vulgaris*, preferably the former, in coarse powder, exhaust it by repeated decoction or digestion in boiling water, and evaporate the filtered liquids to a soft extract. Treat this with stronger alcohol by digestion in a water-bath still at several times until it is exhausted (or until a quart of alcohol has been employed for the extract from each pound of the root). Add to the tincture one-fourth of its bulk of water, distil off five-sixths of the alcohol, and add to the hot watery residue an excess of diluted sulphuric acid, and allow it to cool. The sulphate of berberine crystallises out, and, if necessary, may be drained from the mother-liquid, re-dissolved in the smallest quantity of boiling water, and again crystallised.

The salt is now ready for decomposition by oxide of lead. The latter, as obtained by precipitation from the acetate or nitrate of lead by liquor potassæ, and well washed, and is added in excess, with agitation, to the sulphate of berberine dissolved in boiling water, the solution being kept hot during the decomposition. When a drop of the hot clear liquid will not be precipitated by baryta water or acetate of lead, the digestion is finished. The solution should then be filtered off hot, evaporated, and set aside for crystallisation.

Examined by a lens, berberine crystallises in stellated groups of minute acicular crystals, not so deep in colour as those of the muriate of commerce, or Eclectic *hydrastin*. A grain of berberine, placed in a test-tube, was shaken with repeated additions of water at about 60° F., with intervals of rest, during twenty-four hours, until it had nearly all dissolved—which required seventy-five grains of water. The residue completely dissolved when the quantity was increased to 100 grains. The solution thus obtained was a clear and brilliant yellow colour. When a grain is dissolved by heat in seventy-five grains of water, the excess crystallises out on standing. Berberine is much more soluble in boiling water and in hot alcohol, but it is less soluble in cold alcohol than in water, one grain requiring more than 100 grains of that liquid for solution. Storer, in his "Dictionary of Solubilities," page 67, gives Liebig's numbers for the solubility of berberine, which apply to its hydrochlorate according to Wittstein. It is soluble in acetone and methylic alcohol, whilst chloroform dissolves it but slightly, and ether, oil of turpentine, and oil of almonds, not at all. Acetic acid is one of its best solvents. It is also soluble in cold sulphuric acid, which it colours deep yellow. Nitric acid instantly decomposes berberine, with the production of a dark, mulberry-purple colour, which grows lighter by standing. This reaction is best shown by adding a minute fragment of nitrate of potassa to the solution of berberina in sulphuric acid, when the rich mulberry colour is instantly developed.

When a particle of bichromate of potassa is employed, the colour is much darker, almost purplish-black, and remains so for some time. The saturated aqueous solution yields beautiful crystalline precipitates, with diluted nitric, muriatic, and sulphuric acids, but not with phosphoric, acetic, citric, or tartaric acids. Aqueous iodine renders it opaque, and affords a brown precipitate; tannic acid and iodohydrargyrate of potassium, each a yellow one.

Both the watery and alcoholic solutions have a strong bitter taste. The existence of berberine in several of the natural orders of plants is quite remarkable, and suggests to Mr. Perrins that it probably possesses more valuable properties as a medicine than have yet been accorded to it.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, January 29, 1864.

Colonel Philip James Yorke, *F.R.S., in the Chair.*

Edward Frankland, Esq., F.R.S., Professor of Chemistry, Royal Institution, read a paper "*On the Glacial Epoch.*"

Amongst the circumstances that have profoundly influenced the present physical condition of our earth, the action of ancient glaciers upon a scale of almost inconceivable magnitude has been gradually but irresistibly forcing itself upon the notice of philosophers since their attention was first called to it by Venetz and Esmark. There are few elevated regions in any quarter of the globe which do not exhibit indubitable evidence of the characteristic grinding and polishing action of ice-masses, although at present, perhaps, they are scarcely streaked by the snows of winter. In our own country the researches of Buckland, and especially of Ramsay, have clearly shown that the Highlands of Scotland, the mountains of Wales and Cumberland, and the limestone crags of Yorkshire, abound in these *roches moutonnés*, which leave no doubt that the valleys of those mountain ranges were once filled with glaciers of dimensions unsurpassed, if even equalled, by those which at the present day stream down the sides of their gigantic Swiss rivals. Nor was this perpetual ice of a former age confined to localities where no such phenomenon is now seen, but numerous observations have established that the glaciers of the present age, existing in Switzerland, Norway, and elsewhere, are but the nearly dried-up streamlets of ancient ice-rivers of enormous size. These glaciers have eroded the Alpine valleys, of which they once held possession, have carved out the lochs and kyles of Scotland, as well as the grander fjords of Norway, and have contributed in a most essential manner to the present aspect of our mountain scenery. Ramsay and Tyndall have recently called attention to this action of ancient glaciers, and have contended with considerable plausibility, the former that the lake basins, the latter that the valleys of the Alps, have been thus, in great part, scooped out. In no part of the world, perhaps, can the phenomena of the glacial epoch be more advantageously studied than in Norway, where the ice-scarred coasts and fjords are still fully exposed to the eye of the observer, side by side with the ocean, which furnished the crystalline material that formerly covered them. Two thousand miles of coast, from Christiania to the North Cape, afford almost uninterrupted evidence of the vast ice operations which, during the epoch in question, moulded nearly every feature of this remarkable country. Starting from Christiania, the traveller cannot fail to remark the peculiar appearance of the gneiss and granite rocks composing the coast, as well as the innumerable islands which, forming a great natural breakwater, protect the shore from the heavy seas rolling in from the Atlantic. These rocks, here rarely rising to the height of 800 or 900 feet, present nothing of that sharp and rugged outline which generally characterises such formations. On the contrary, they are smoothed even to their summits, all their angles worn off, and every trace of boldness and asperity effaced. To the casual and uninstructed observer the action of the sea suggests itself as a sufficient cause of these appearances; but it does not require much scrutiny to be convinced that the ocean waves have had little to do with this smoothing and polishing of the coast, since it is the surfaces sloping towards the land that are most acted upon, whilst in some places, where the rock descends precipitously towards the sea, and is subject to the dash of the waves, it has been protected from the abrading action, and presents merely a weathered surface.

Rounding the promontory of the Naze, and proceeding northward, the coast presents, with slight exceptions, the same general features until the Arctic circle is approached, when the character of the scenery rather suddenly changes. The rocky hills acquire the dignity of mountains, and tower up in rugged, sharp, and fantastic peaks, contrasting strongly with the rounded summits of the lower latitudes. But these arctic peaks owe their immunity from the abrading action of ice solely to their height; around their bases, and even high up their sides, the slow surges of the moving glacial sea have made their unmistakable marks, grinding, and even undercutting, them into most extraordinary forms, as fine instances of which may be mentioned the Seven Sisters, and Torghatten, with its singular tunnel, just south of the Arctic circle; the Horseman, standing on the circle; and the mountains of the Folden and Vestfjords, north of it; the latter having been justly described by the Rev. R. Everest, as resembling the jaws of an immense shark.*

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* The speaker was greatly indebted to his friend, B. F. Duppa, Esq., for beautiful coloured drawings of these remarkable objects, taken from the sketches of Professor James D. Forbes and Mr. Mattieu Williams.

To account for the advent and subsequent disappearance of such vast masses of ice, various hypotheses have been propounded. It has been suggested that the temperature of space is not uniform, and that our solar system, in performing its proper motion among the stars, sometimes passes through regions of comparatively low temperature; according to this hypothesis, the glacial epoch occurred during the passage of our system through such a cold portion of space. Some have imagined that the heat emitted by the sun is subject to variation, and that the glacial epoch happened during what may be termed a cold solar period. Others, again, believed that a different distribution of land and water would render the climate of certain localities colder than it is at present, and would thus sufficiently account for the phenomena of the glacial epoch. Finally, Professor Kämtz considers that at the time of the glacial period the mountains were much higher than at present—Mount Blanc 20,000 feet, for instance—the second and tertiary formations having been since eroded from their summits.

The two last assumptions are attended with formidable geological difficulties, especially when it is considered that the phenomena of the epoch in question extended over the entire surface of the globe; they have, therefore, never acquired more than a very partial acceptance. With regard to the two first-named hypotheses, my colleague, Professor Tyndall, has recently shown that they are founded upon an entirely erroneous conception of the conditions necessary to the phenomena sought to be explained. The formation of glaciers is a true process of distillation, requiring heat as much as cold for its due performance. The produce of a still would be diminished, not increased, by an absolute reduction of temperature. A greater differentiation of temperature is what is required to stimulate the operation into greater activity. Professor Tyndall does not suggest any cause for such exalted differentiation during the glacial epoch; but he proves conclusively that both hypotheses, besides being totally unsupported by cosmical facts, are not only incompetent to constitute such a cause, but also assume a condition of things which would cut off the glaciers at their source, by diminishing the evaporation upon which their existence essentially depends.

The speaker divided the great natural glacial apparatus into three parts, viz., the evaporator, the condenser, and the receiver. The part performed by the ocean as the evaporator is too obvious to need description. The two remaining portions of the apparatus, however, are generally confounded with each other. The mountains are in reality the receivers, or icebearers, and are only in a subordinate sense condensers. The true condenser is the dry air of the upper region of the atmosphere, which permits of the free radiation into space of the heat from aqueous vapour.†

All the hypotheses hitherto propounded having therefore failed in the light of recent research, to account for the conditions which brought about the glacial epoch, the speaker felt less reluctance in advancing a new theory, which had gradually elaborated itself out of the impressions he had received during a recent visit to Norway. Any such theory must take cognisance of the following points in the history of the glacial epoch:—1st, That its effects were felt over the entire globe. 2nd, That it occurred at a geologically recent period. 3rd, That it was preceded by a period of indefinite duration, in which glacial action was either altogether wanting, or was at least comparatively insignificant. 4th, That during its continuance atmospheric precipitation was much greater, and the height of the snow-line considerably less than at present. 5th, That it was followed by a period extending to the present time, when glacial action became again insignificant.

All these conditions he believed to be the natural sequences of the gradual secular cooling of the surface of our globe. The sole cause of the phenomena of the glacial epoch was a higher temperature of the ocean than that which obtains at present.

He then examined the grounds upon which this hypothesis is based. Numerous observations of the augmentation of temperature, at increasing depths from the surface of the earth, no longer leave room for doubt that the vast mass of materials constituting the interior of our globe is at the present moment at a temperature far higher than that of the surface. If this be so, the conclusion is almost inevitable, that at earlier periods of the earth's history this high temperature must, at all events at depths comparatively little removed from the surface, have been still higher, and that consequently the temperature of the surface itself must in former ages have been much more influenced by the internal heat than is the case at the present day. Tracing thus back the thermal history of our earth, it is conceivable that the waters of the ocean once existed as aqueous vapour in our atmosphere—a condition which it is imagined obtains at the present day in Jupiter, Venus, and other planets, whose superior size or closer proximity to the sun may be supposed to have retarded the refrigeration of their surfaces. From the period, therefore, when the cooling of the earth's crust permitted the ocean to assume the liquid condition, its waters have gradually cooled from the boiling point down to the present temperature, whilst the land has also undergone a similar process of refrigeration. It was during the later stages of this cooling operation that the glacial epoch occurred. For this assumption, however, it is necessary to establish that the rate of cooling of the land and of the ocean surfaces was unequal, otherwise the more rapid evaporation of the ocean due to increased temperature would be more or less neutralised by the impaired efficiency of the proportionately warm icebearers. The speaker then proceeded to describe the results of his numerous experiments, which conclusively proved that, under the conditions contemplated, the land would cool more rapidly than the sea. This effect is brought about principally by two causes, viz., the great specific heat of water compared with granite and other rocks, and the comparative facility with which radiant heat escapes from granite through moist air. The amounts of heat associated with equal weights of water and granite are as 5 to 1 in favour of the former, or, if equal volumes be taken, the water requires to lose twice as much heat as the granite in order to cool through the same number of degrees; but it is in regard to the escape of radiant heat from their surfaces that the superior retention of warmth by the oceanic waters is most strongly marked. The readiness with which radiant heat escapes from equal surfaces of water and granite at the same temperature through perfectly dry air is nearly equal; but so soon as aqueous vapour is interposed in the path of these rays, the conditions become wonderfully altered; the escape of heat from both is interrupted, but its radiation from the water is retarded in by far the greatest degree. This extraordinary intranscalency of aqueous vapour to rays issuing from water has just been conclusively proved in the physical laboratory of this Institution by researches made by Professor Tyndall, and not yet published. The difference between granite and water arising from this cause becomes vastly augmented when it is considered that the icebearing surfaces occupy an elevated position above the level of the sea, consequently the mantle of aqueous vapour which their radiant heat had to penetrate must have been much more attenuated than the comparatively dense shell lying between them and the surface of the ocean. Thus the obscure rays of heat streamed into

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† This radiation from aqueous vapour was experimentally shown by causing a jet of dry steam to pass in front of, and at a distance of two feet from, a thermo-electric pile; the galvanometer connected with the latter promptly showed a large deflection for heat, proving that the pile was receiving radiant heat from the aqueous vapour. A jet of air heated in the same manner and projected in front of the pile produced no such effect.

space from the icebearing surfaces with comparatively little interruption, whilst the radiation from the sea was as effectually retarded as if the latter had been protected with a thick envelope of non-conducting material.

Whether we take into consideration, therefore, the conductivity of water and granite, their specific heats, or, finally, the respective facilities with which they can, under the cosmical conditions contemplated, throw off their heat into space, we find everywhere a state of things tending much more to the conservation of the heat of the water than to the retention of that of the land; and this of course applies also, *mutatis mutandis*, to the retention of that heat which is received from solar radiation. The luminous heat-rays of the sun pass freely through aqueous vapour, and are absorbed by both granitic and oceanic surfaces, but, once absorbed, these rays issue forth again as obscure heat of two different qualities, or rates of vibration. To use Tyndall's beautiful explanation of the phenomenon, the vibrations of the liquid water molecules are of such rapidity as can be best taken up and absorbed by the same molecules in the vaporous condition. But granite is a very complex substance, and fewer of the heat oscillations of its atoms are in unison with those of aqueous vapour: hence the heat vibrations of granite disturb the molecules of aqueous vapour in their passage through the atmosphere in a less degree, and consequently the granitic rays are less absorbed.

Thus, whilst the ocean retained a temperature considerably higher than at present, the icebearers had undergone a considerably greater refrigeration. The evaporation from the ocean would therefore, at the period contemplated, be greater than it is at present, whilst the capabilities of the icebearers, as such, would not be perceptibly less. Moreover, it is evident that during the whole of the cooling period the ocean must have been receiving heat from its floor, and thus have acted as a carrier of warmth from the comparatively profound portions of the earth's crust to the oceanic surface. It thus resembled a mass of water contained in an evaporating basin, placed over a very slow and gradually declining fire. Under such conditions its cooling was protracted through a vast period, allowing sufficient time, between a temperature inimical to animal life and the commencement of the glacial epoch, to permit of the development and decay of those forms of animal life which existed in the preglacial seas.

The rate of evaporation of water at different temperatures and under various circumstances was determined by Dalton, whose results are embodied in the following table. The evaporation took place in each case from a circular surface six inches in diameter:—

Temp. F.	Evaporation per minute in Calm. grains.	Evaporation per minute in Breeze. grains.	Evaporation per minute in High Wind. grains.
85°	4·92	6·49	8·04
75°	3·65	4·68	5·72
65°	2·62	3·37	4·12
55°	1·90	2·43	2·98
45°	1·36	1·75	2·13
35°	·95	1·22	1·49

We have no sufficient data to calculate the present mean temperature of the ocean, but in lat. 69° 40′ off the coast of Norway, at noon on a remarkably hot summer's day, Professor Forbes found the temperature to be 46·5° Fahr. The assumption of 40° Fahr. as the mean temperature off the coast of Norway would, therefore, probably be in excess of the truth. Now, taking the mean of Dalton's results obtained at 35° and 45°, and comparing it with the mean of his results at 55° and 65°, it will be seen that an increase of 20° in the temperature of the ocean off the coast of Norway would double the evaporation from a given surface. Such an increased evaporation, accompanied as it necessarily must be by a corresponding precipitation, would suffice to supply the higher portions of the land with that gigantic ice-burthen which groaned down the mountain slopes during the glacial epoch.

But would not the increased oceanic temperature tend to augment the mean temperature of the atmosphere even at considerable elevations, and thus raise the snow-line and reduce the area of perpetual snow? In answering this question, the speaker showed that the limit of perpetual snow does not depend so much upon the mean temperature of the atmosphere at that particular elevation, as upon the amount of snow accumulating during the cold season. Under the equator, the mean temperature of the snow-line is 35° F.; in the Alps and Pyrenees, about 25°; and in lat. 68°, in Norway, it is only 21°. Thus the mean temperature of the snow-line rises as we approach the equator, which means that the snow-line itself descends below its normal height, owing principally to augmented oceanic evaporation, accompanied by increased atmospheric precipitation. The deluges of rain which fall within the tropics far surpass the rainfall in the temperate and frigid zones, and doubtless the fall of snow upon intertropical mountains is proportionately great. The important influence which the amount of precipitation exercises upon the lower limit of perpetual snow is beautifully exemplified at the fine waterfall of Tysse Strenger, near the head of the Hardanger Fjord, and was first noticed by Mr. M. Williams. The spray from this fall, being frozen in winter, covers the valley for nearly half a mile with a stratum of snow and ice, so thick as to defy the solar rays of summer to melt it; thus lowering the snow-line by more than 2000 feet. The speaker had also seen in the Sör Fjord, under similar abnormal conditions, a mass of snow lying, in the month of August last, within 10 feet of the level of the sea, although the normal snow-line is there at least 4500 feet above the sea-level. That the height of the snow-line is essentially dependent upon the amount of precipitation, and not upon mean temperature, is evident from a comparison of its height on the coast and in the interior of the Scandinavian peninsula, as given by Forbes in the following table, compiled partly from his own observations and partly from those of Von Buch, Naumann, and others:—

	Height of Snow-line in feet.		
Latitude.	Coast.	Interior.	Difference.
60°	5500	4450	1050
62°	5200	4150	1050
64°	4200	3650	550
66°	3700	3250	450
68°	3450	3000	450
70°	3350	2900	450

Thus the difference between the height of the snow-line near the coast, where, owing to the impact of the gulf-stream, the winter is mild but the atmospheric precipitation great, and in the interior, where the climate is severe but the air comparatively dry, amounts, in some cases, to as much as 1050 feet, or nearly one-fourth of the total height. Such is the depressing effect of greater precipitation as regards the limit of perpetual snow. Nor must it be forgotten that copious precipitation is altogether incompatible with great summer-heat. The incessantly-clouded sky cuts off the solar rays, and moderates the summer temperature. It is a trite observation that a wet summer is always a cold one. The mean temperature of the land in contiguity with such extensive surfaces of snow could also not fail to be considerably reduced; for, although the actual amount of heat in activity at the surface of the earth was greater during the glacial period than subsequently, yet the cold of winter became stored up in masses of falling snow, which in melting absorbed the heat of the succeeding summer, and thus reduced both the mean and summer temperature of the land, especially of such portions of it as were not situated greatly below the snow-line. The common notion, therefore, that the glacial epoch was a cold one is correct, although heat, not cold, was the cause of that epoch. This apparent paradox, that heat should be the cause of cold, finds its parallel in the ice-making machines which were in operation at the last Great Exhibition. In those machines which produced from 2 to 12 tons of ice per ton of coal, the glacial produce was directly proportional to the amount of heat developed by the combustion of coal.

But it is evident that this lowering of the snow-line by increased oceanic temperature could only occur within certain limits; for, although the mean temperature of the snow-line might rise from 21°, its present position in Norway, to 35°, its height under the equator, and perhaps even still higher, without any elevation of the snow-line itself; yet a further rise of mean temperature, which would result from a continued augmentation of oceanic heat, could not fail to elevate the snow-line itself, and eventually to chase the last portions of snow even from the loftiest mountain peaks. A process the inverse of this has gone on in nature, leading gradually to the glacial epoch, and eventually to the present meteorological condition of our globe. Whilst the ocean maintained a high temperature, the snow-line floated above the summits, possibly even of the most lofty mountains; but with the reduction of oceanic temperature it gradually descended, enveloping peak after peak in a perennial mantle, until during the glacial epoch it attained its lowest depression, whence it again rose, owing to diminished evaporation, to its present position.

The speaker considered that, inasmuch as recent researches had rendered all previous hypotheses regarding the glacial epoch absolutely untenable, the one for which he now contended could not be said to come into antagonism with any other views. It also further commended itself by requiring the assumption of no natural convulsion or catastrophe, no vast or sudden upheavals or depressions, and no change in the thermal relations of our earth to the sun or to space. On the contrary, it insisted that the glacial epoch was normally and gradually evolved from a thermal condition of the interior of our globe, which could scarcely be said to be any longer the subject of controversy.

In conclusion, this hypothesis suggests the probability that the other bodies belonging to our solar system have either already passed through a similar epoch, or are destined still to encounter it. With the exception of the polar ice of Mars we have hitherto obtained no certain glimpse into the thermal or meteorological condition of the planets: neither is the physical state of their surfaces accessible to our best telescopes. It is otherwise however with the moon, whose distance is not too great to prevent the visibility of comparatively minute details. A careful observation of the lunar surface for more than a year with a silvered glass reflector of seven inches' aperture and of good defining power, had created in the speaker's mind an impression that our satellite had, like its primary, also passed through a glacial epoch, and that several at least of the valleys, rills, and streaks of the lunar surface were not improbably due to former glacial action. Notwithstanding the excellent definition of modern telescopes, it could not be expected that other than the most gigantic of the characteristic details of an ancient glacier bed would be rendered visible. Under favourable circumstances the terminal moraine of a glacier attains to enormous dimensions; and consequently, of all the marks of a glacial valley, this would be the one most likely to be first perceived. Two such terminal moraines, one of them a double one, appeared to him to be traceable upon the moon's surface. The first was situated near the termination of that remarkable streak which commences near the base of Tycho, and passing under the south-eastern wall of Bullialdus, into the ring of which it appears to cut, is gradually lost after passing crater 216 (Lubinietzky). Exactly opposite the last crater, and extending nearly across the streak in question, are two ridges forming the arcs of circles, whose centres are not coincident, and whose external curvature is towards the north. Beyond the second ridge a talus slopes gradually down northwards to the general level of the lunar surface, the whole presenting an appearance reminding the observer of the concentric moraines of the Rhone glacier. These ridges are visible for the whole period during which that portion of the moon's surface is illuminated, but it is only about the third day after the first quarter and at the corresponding phase of the waning moon (when the sun's rays falling nearly horizontally, throw the details of this part of the surface into strong relief) that these appearances suggest the explanation now offered.

The other ridge, answering to a terminal moraine, occurs at the northern extremity of that magnificent valley which runs past the eastern edge of Rheita. This ridge is nearly semicircular, and is considerably elevated, both above the northern termination of the valley, and the general surface of the moon. It may be seen about four days after new and full moon, but the position of the observer, with regard to the lights and shadows, renders its appearance in the rays of the rising sun by far the most striking.

With regard to the probability of former glacial, or even aqueous, agency on the surface of the moon, difficulties of an apparently very formidable character present themselves. There is not only now no evidence whatever of the presence of water, in any one of its three forms, at the lunar surface; but, on the contrary, all selenographic observations tend to prove its absence. Nevertheless, the idea of former aqueous agency in the moon is by no means new. It was entertained by Gruithuisen and others. But if water at one time existed on the surface of the moon, whither has it disappeared? If we assume, in accordance with the nebular hypothesis, that the portions of matter composing respectively the earth and the moon once possessed an equally elevated temperature, it almost necessarily follows that the moon, owing to the comparative smallness of its mass, would cool much more rapidly than the earth; for whilst the volume of the moon is only about $\frac{1}{49}$th, its surface is nearly $\frac{1}{13}$th, that of the earth.

This cooling of the mass of the moon must, according to all analogy, have been attended with contraction, which can scarcely be conceived as occurring without the development of a cavernous structure in the interior. Much of this cavernous structure would doubtless communicate by means of fissures with the surface, and thus there would be provided an internal receptacle for the ocean, from the depths of which even the burning sun of the long lunar day would be totally unable to dislodge more than traces of aqueous vapour. A globe of wax was exhibited which had been cast under water; it was highly cellular, and the water had been forced into the hollow spaces, completely filling them. Assuming the solid mass of the moon to contract on cooling at the same rate as granite, its refrigeration through only 180° F. would create cellular space equal to nearly 14½ millions of cubic miles, which would be more than sufficient to engulf the whole of the lunar ocean, supposing it to bear the same proportion to the mass of the moon as our own ocean bears to that of the earth.

If such be the present condition of the moon, we can scarcely avoid the conclusion that a liquid ocean can only exist upon the surface of a planet, so long as the latter retains a high internal temperature. The moon then becomes to us a prophetic picture of the ultimate fate which awaits our earth, when deprived of an external ocean and of all but an annual rotation upon its axis,[‡] it shall revolve around the sun an arid and lifeless wilderness,—one hemisphere exposed to the perpetual glare of a cloudless sun, the other clouded in eternal night.

[‡] Mayer has recently proved that the action of the tides tends to arrest the motion of the earth upon its axis. And although it has been proved that since the time of Hipparchus the length of the terrestrial day has not increased by the one-hundredth part of a second, yet this fact obviously leaves untouched the conclusion to which Mayer's reasoning leads.

ACADEMY OF SCIENCES.

February 22.

M. Moride communicated "*A Process for Reviving Writing almost Effaced upon Deeds and Parchments.*" He first soaks the parchment in distilled water; after draining, he immerses it for a second or two in a weak solution of oxalic acid; he then rapidly washes it, and afterwards places it in a closed vessel containing a solution of gallic acid (10 grammes to 300 grammes of distilled water); finally, as soon as the characters appear, he well washes the manuscript with a large quantity of water, and dries it between leaves of blotting-paper. These operations require great care and delicacy, or the manuscript may become hopelessly defaced, especially if it be left too long in the gallic acid solution, exposed to the influence of air and light. The Academy, in fact, condemns it, and says that librarians and keepers of archives would not be justified in performing this experiment upon public documents.

M. E. Renon communicated a note "*On the Limits of Perpetual Snow.*" The author announces his discovery of the following law:—"In all countries in the world the limit of perpetual snow is the height at which the hottest half of the year has a mean temperature equal to that of melting ice." The observations hitherto made are so defective, and the decrease of temperature with height, in different seasons, are so little known, that the author does not hope to completely verify the law, but he shows that there is an agreement as satisfactory as possible in the present state of our knowledge.

A note "*On the Atomicity of Oxygen, Sulphur, Selenium, and Tellurium,*" by M. A. Naguet, was presented. The author is disposed to consider all these elements tetratomic. His reasoning is curious, and we shall translate the note at length.

CHEMICAL SOCIETY OF PARIS.

January 22, 1864,

M. Ad. Wurtz *in the Chair.*

In commencing the business of the evening, M. Wurtz expressed his thanks to the Society for the honour they had conferred upon him, and briefly glanced over the services which had been rendered to science by his predecessor, M. H. Deville.

MM. Vidal, Descamps, and Lacote were elected resident members, and M. J. Riban was elected "non-resident" member.

M. Friedel read the report of the committee on accounts. Their conclusions were adopted.

M. Berthelot gave an account of his researches on the oxidation of wine.

M. Riban, in presenting to the Society a memoir on the active principle of the Redoul (Sumach), briefly mentioned his researches, and exhibited a fine specimen of crystallised coryamirtine.

M. De Luynes announced that he had succeeded in solidifying butylene.

M. De Luynes gave an account of some researches undertaken by him, in conjunction with M. G. Salet, on the employment of hydriodic acid in organic chemistry.

M. Cloez described a method of analysing organic acids, when combined with potash or soda. The organic matter is mixed with tungstic acid, and burned in a current of pure and dry air.

M. Cloez also announced a means of separating glucose from chloride of sodium, by the employment of acetate of silver. The soda is precipitated with concentrated oxalic acid, and the evaporated solution extracted with alcohol, which only dissolves the glucose.

M. Wurtz gave an account of several results obtained by M. Carius on the fixation of hypochlorous acid and oxygenated water on hydrocarbons. They recall an observation of Mr. Attfield, who has shown that oxygenated water, in uniting with hydrocyanic acid, forms oxamide.

PHARMACEUTICAL SOCIETY.

February 17.

Dr. Redwood delivered a lecture on the British Pharmacopœia, which was listened to with great satisfaction by a crowded audience. After a brief historical allusion to the pharmacopœias which have been superseded by the British, the lecturer proceeded to give a short general sketch of the changes made in the chemical preparations, and then referred to some preparations which he considered to require particular notice. *Acidum Aceticum Glaciale* he said could not be obtained by the process given in the Pharmacopœia, and he regretted that the Committee had not rested satisfied, as in the case of acetic acid, with describing the article they intended. The increase of strength in the mineral acids the lecturer considered disadvantageous. The new hydrochloric acid has a greater tendency to give off vapours when exposed to the air. To the nitric acid stronger objections applied. Acid of the gravity 1·5 is not a commercial product; it will not keep colourless, for it is constantly undergoing decomposition, under the influence of light, losing strength, and becoming contaminated with nitrous acids. The sulphuric acid is described as monohydrated, but the gravity given is the gravity of a weaker acid. The process directed for obtaining the acid will not yield the monohydrated, which Dr. Redwood considered a fortunate circumstance, since this acid congeals in cold weather, and would be inconvenient to use. The alkalies were next alluded to, and the alterations of strength in the solutions were pointed out. These were shown in the following tables:—

	Ph. Lond.	Ph. Brit.
Liquor ammoniæ . .	0·960	0·959
Liquor ammoniæ fortior .	0·882	0·891
Liquor potassæ . .	1·063	1·058
Liquor sodæ . . .	1·061	1·047

The greatest alteration, it will be seen, has been made in the case of liquor sodæ. The carbonate of potash $KOCO_2 2HO$, described in the British Pharmacopœia, is a salt which cannot be obtained in commerce, and is very difficult to make. Carbonate of potash of commerce contains only about an atom and a-half of water, or sixteen per cent. The process for making tartar emetic Dr. Redwood commended as an improvement. In those for ferrum tartaratum and ferri et ammoniæ citras too much water is ordered, and the dilute solutions obtained cannot be scaled according to the directions. The process for making spiritus etheris nitrosi might be good if pure nitrite of soda could be obtained. Unfortunately, the process for the preparation of this salt given in the Pharmacopœia does not yield the product required. The samples of the salt examined by the lecturer consisted principally of nitrate of soda, with much carbonate and very little nitrite. The product of the Pharmacopœia process will always be variable, and consequently the spirit of nitre is not likely to be uniform in composition. Collodium was next referred to, and the lecturer said that the process given for making pyroxylin would produce excellent gun-cotton, which will be insoluble in the mixture of alcohol and ether. One other preparation was referred to—distilled water. "The description," Dr. Redwood said, "given of the distilled water directed to be used in pharmacy affords a good illustration of what appears to me to be a defect in many parts of the work, and that is, an attempt at too great refinement. We are told that distilled water should answer to the following character among others—namely, 'that a fluid ounce of it evaporated in a clean glass capsule leaves no visible residue.' Now, I should like to see such distilled water made by simple distillation in a copper still, as described in the Pharmacopœia. In the instruction of pharmaceutical pupils I have been accustomed to set them the task of producing such distilled water, as one which they would think very easy, but which experience proves to be attended with considerable difficulty."

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(FOURTEENTH NOTICE.)

(Continued from page 107.)

Dr. Hofmann very properly claims the discovery of aniline red. The first mention of it will be found in vol. ix., p. 284, of the *Proceedings of the Royal Society.* It was obtained by the action of fuming nitric acid upon aniline. The first industrial process was devised by MM. Verguin and Rénard, of Lyons, who procured the colour by the action of tetrachloride of tin upon aniline. These gentlemen also first applied the colour to dyeing and printing. Numerous processes have since been invented for the production of *rosaniline,* as the colour is now called, most of which have been noticed in our columns. A brief account of them here, however, will not be out of place.

The original process of MM. Rénard Frères was the following:—A mixture of ten parts of aniline and from six to seven of tetrachloride of tin is heated to boiling for fifteen or twenty minutes. The liquid, at first yellow, becomes more and more red, until the mass appears black. A solution in boiling water may be used at once for dyeing; but it is better to purify the colour by neutralising a concentrated solution with carbonate of soda, and then adding a quantity of common salt, whereby the colouring matter is precipitated in a solid state. The precipitate has only to be dissolved in water, alcohol, or acetic acid to prepare a dye for imbuing silk and wool with the most beautiful roseate tints.

Gerber Keller's process soon followed. He treats aniline with mercuric nitrate in the dry. To ten parts of aniline placed in a water-bath, seven or eight parts of the powdered mercuric nitrate are gradually added, with constant stirring. The operation lasts eight or nine hours, at the end of which time the mass becomes of a beautiful violet red colour. This constitutes the azaléine of commerce. This process, the reporter says, may be considered really useful.

Lauth and Depouilly treat aniline with nitric acid. The aniline must be in excess. The mixture must be carefully heated to 150° or 160° C., and the heat must be removed quickly if the action becomes lively, or combustion may take place.

This process succeeds well, but can only be safely conducted on a small scale. After several hours, a mass of violet red is obtained, from which the colouring matter may be separated with carbonate of soda and common salt, as in Rénard's process.

The method by means of arsenic acid the Reporter ranks among the best. Twelve parts of commercial arsenic acid and ten parts of aniline, with or without the addition of water, are heated over a slow fire to about 120° or 140°, taking care not to exceed 160° C., until the mass solidifies on cooling to a hard substance with a bronze-coloured lustre. The operation lasts, according to the quantities used, from four to nine hours. When the bronze-coloured substance is dissolved in water, a solution of great richness is obtained from it; a slight excess of soda will precipitate the colouring matter. The precipitate is filtered off, washed, and redissolved in acetic acid.

A detailed account of this operation as it is carried out by the MM. Rénard, at Lyons, is here extracted from M. Wurtz's report on the colouring matters derived from coal tar, contributed to the reports of the French section of the Jury of the International Exhibition. We quote it here, as probably neither that nor the present report will reach many of our readers who are interested in these colours:—

"A very concentrated solution of arsenic acid, containing 76 per cent. of the solid acid [hydrate or anhydride?], is mixed with aniline, manufactured from either English or Belgian benzol. For twenty parts of the syrupy arsenic acid twelve parts of commercial aniline, which is not anhydrous, are taken, and forty kilogrammes of this mixture are introduced into a cast-iron retort, the dimensions of which, on account of the powerful intumescence during the reaction, should considerably exceed the bulk of the mixture. The retort is placed over the vault of a furnace, where it is heated in an air bath, the temperature of which must not exceed from 150° to 170° C. From time to time a workman plunges a rod into the mass, and as soon as the substance which adheres exhibits on cooling a bronzy colour and a brilliant fracture the operation is terminated. The time required for this purpose varies from three to four hours. The product of the fusion is then poured upon cast-iron plates, from which, after solidification, it is detached, reduced into fragments, and removed to another part of the establishment, in order to be exhausted. For this purpose it is digested in large cast-iron tanks, with twice its weight of hydrochloric acid. The operation lasts from two to two and a-half hours; and, during the whole of this time, a current of steam is passed through the liquid, which becomes rapidly charged with the colouring matter. As soon as the residue has become pulverulent, the liquid is thrown upon a strainer of woollen material. The filtered liquid falls into a large cast-iron vessel, containing an excess of a solution of carbonate of sodium. The colouring matter is thus separated in flakes or granules, which, under the influence of a current of steam, unite and rise to the surface of the liquid, whence it is removed by perforated ladles. The substance thus obtained is introduced into large tanks of cast-iron, and submitted, in the presence of a considerable quantity of water, to the action of a current of steam. A great deal of colouring matter dissolves in the liquid, which is separated by filtration from a new deposit, and allowed to cool in large vessels of iron-plate, in which green crystals of a coppery lustre are deposited.

"If, in the treatment of aniline with arsenic acid, the latter be considerably increased beyond the proportions above given, violet, and even blue colouring matters are produced, the formation of which has been patented by MM. Girard and De Laire."

MM. Laurent and Casthélez have a process by which they transform nitrobenzole into the colouring matter without the preliminary isolation of the aniline. "Nitrobenzole is treated with a mixture of iron and hydrochloric acid, or with ferrous chloride. In this operation the nitrobenzole is converted into aniline, and ferric chloride is produced. On heating this mixture, the ferric chloride reacts upon the aniline, transforming it into aniline red." MM. Laurent and Casthélez have given the name of *erythrobenzole* to the colouring matter thus obtained; but it probably consists principally of rosaniline. This method is ingenious, and if the product be equal, in point of quantity and quality, to that obtained by the previously prepared aniline, it must be an economical plan, since it dispenses entirely with one rather delicate operation, and thus diminishes the amount of labour required.

The above may be called the practical processes for the production of rosaniline. For numerous others, we must refer our readers to this Report, or vol. ii., p. 244, of the Chemical News. At that time we spoke strongly in condemnation of a patent taken out in this country by M. Gerber Keller, in which it seemed to be the object of the patentee to claim everything which could by any possibility produce the colour. Speaking of this particular patent, the Reporter makes the following observations:—"Of such patents scientific men cannot speak otherwise than in terms of reprehension. Their claims are founded on random guesswork, not on the results of patient investigation. They are attempts to pre-occupy the whole field, and forestall all the rewards which should be left open to real inventive genius to cultivate and win. It would [in the Reporter's opinion] be well that such patents, on due proof of their character, should be set aside by the tribunals." We will go further, and state our own opinion that a petition for a patent of this kind should be instantly dismissed.

Before proceeding to the "Researches on the Nature of Aniline Red," we will extract a foot note relating to the production of arsenic acid:—

"This acid was first produced upon a large scale by M. E. Kopp (*Ann. Chem. Phys.*, [3] xlviii., 106), who, during the high price of tartaric acid in the years 1853 and 1854, suggested the employment of arsenic acid for the white discharge of Turkey red,—an application which, to a certain extent, has continued ever since, although the price of tartaric acid has fallen again. M. Kopp employs nitric acid to convert arsenious acid by oxidation into arsenic acid; and, by passing the nitrous acid fumes evolved, together with air, over coke moistened with water, he recovers from two-thirds to three-fourths of the nitric acid employed. The proportions he adopts are 303 kilogrammes of nitric acid of 1·35 sp. gr. to 400 kilogrammes of powdered arsenious acid; and by adding the nitric acid gradually he finds that the oxidising action may be accomplished without the application of heat. The above method is used with advantage by the manufacturers who prepare arsenic acid for the production of rosaniline. The Reporter lately saw this operation at the celebrated works of M. Charles Kestner, at Thann, where 100,000 kilogrammes of arsenic acid, the order of a single manufacturer of aniline red (Messrs. J. J. Müller and Co., of Basle) were in course of preparation. The oxidation was effected in large glass flasks connected with a lead pipe, by which the copiously-evolved nitrous fumes were discharged into one of the leaden chambers on the premises.

"M. Kopp, while working with arsenic acid, made the peculiar observation that, without any detriment to his general health, a natural tendency to *embonpoint* was considerably enhanced during his operations. In the course of ten weeks M. Kopp had increased in weight not less than ten kilogrammes, which he lost again when his experiments with arsenic acid were discontinued. The Reporter has been informed that the work-people engaged in the production of rosaniline are affected in a similar way."

A Manual of Photographic Chemistry, Theoretical and Practical. By J. F. Hardwick. Seventh Edition. Edited by G. Dawson, M.A., &c., and E. Hadon, F.C.S. London: Churchill and Sons. 1864.

It is not necessary to say anything in praise of a book which has reached a seventh edition. A few alterations and additions, however, have been made in this edition which deserve a word of commendation. The editors have done their work extremely well, and the much-respected author still appears as the guide, philosopher, and friend to all photographers who desire to have an intelligent appreciation of the art.

Annalen der Chemie und Pharmacie. February, 1864.

The number of this valuable periodical just received contains several papers of interest. The first, by Strecker, "*On a New Class of Organic Nitrogen Compounds*," gives an account of azobenzoic acid,—an acid obtained from nitrobenzoic acid by the action of sodium amalgam.

$$\underset{\text{Nitrobenzoic acid.}}{C_{14}H_5(NO_4)O_4} + 4Na = \underset{\text{Azobenzoic acid.}}{C_{14}H_5NO_4} + 4NaO.$$

Some of the salts and the ether of this acid are described, as well as a derivative—hydrazobenzoic acid.

A paper "*On Citramalic and Citratartaric Acids*," by Carius, gives a further account of these acids previously described. The same author announces the discovery of a new fatty acid in the glandular secretion of the hyæna, and hence called hyænic acid. It is remarkable for the high number of the carbon, the formula being $C_{25}H_{50}O_2$. Beyond this, and a slight musky smell, it does not seem to possess much interest. A learned paper by Wislicenus, "*On the Poly-Equivalent Organic Acids*," is a valuable contribution to the chemistry and philosophy of substitution products. An important communication by Claus, "*On the Behaviour of Sulphide of Mercury to Sulphide of Ammonium*," contradicts all analytical books by the assertion that the former body is soluble in the latter. We shall translate this paper. A communication on the occurrence of inosite, by Dr. Marmé, shows that this principle is very commonly present in vegetables. August Streny describes fluochromate of potash, a new fluorine compound; and also a tribasic aresenite of lead oxide, $3PbO + AsO_3 + HO$.

A short paper "*On Narceine*," by Hesse, confirms Anderson's analysis of that alkaloid, and describes some of its salts. The same author, in a shorter communication, denies the existence of a volatile alkaloid in arnica. Hugo Schiff contributes a short notice of the colouring matters derived from naphthylamine, showing that the chemical constitution of these and the aniline colours is different.

NOTICES OF PATENTS.

2870. *Bearings, Steps, Axle-boxes, &c.* P. S. Deolan, Buckingham Street, Strand, London. Dated October 24, 1862.

The inventor describes three compositions which are useful for packing steam machinery, and for the linings of bearings, axle-boxes, and other surfaces exposed to friction. No. 1 composition consists of asbestos, or other mineral fibrous substance, incorporated with graphite, talc, or stealite, and any one of a series of gums the addition of which is intended to secure the perfect adhesion of the whole. Of the gums which are suitable for this purpose, the inventor particularly enumerates dextrine, gutta-percha, gums Arabic, tragacanth, and cowrie. No. 2 composition is similar, but, instead of asbestos, the employment of combinations of albumen with leather, or other animal fibrous substance reduced to pulp, or of mixtures containing glue and starch with the unctuous minerals already specified, is recommended. No. 3 composition differs from the foregoing only by the substitution of cotton, hemp, or other fibrous vegetable substance, for the animal and mineral fibres before described.

The comprehensive nature of the claim renders it impossible to avoid the use of anti-friction materials, which, alone or combined in a manner very similar to the above, have already been applied to the purposes herein mentioned. There cannot be any doubt regarding the efficacy of these compositions; and the extent to which they are susceptible of modification by using animal, vegetable, or mineral fibres, according to the heat of the bearings and other circumstances, renders them universally applicable.

2881. *Apparatus for Testing the Explosibility of Liquid Hydro-carbons.* E. A. L. Negretti and J. W. Zambra, Hatton Garden, London. A communication. Dated October 25, 1862. (Not proceeded with.)

This is a little instrument constructed for the purpose of indicating the lowest degree of temperature at which the vapour given off by a liquid hydrocarbon forms an explosive mixture with the air. It consists of a cup or metallic vessel heated by a water bath or naked spirit flame, and a thermometer with its bulb dipping into the liquid to be tested. The apparatus is particularly applicable for testing the safety of paraffine and petroleum oils intended to be burnt in lamps.

2885. *Heating Glass Furnaces.* J. H. Johnson, Lincoln's Inn Fields, London. A communication. Dated October 27, 1862.

The inventor employs for melting glass the waste gases which are given off during the burning of coke. A direct communication is made by means of flues between the coking oven and the glass furnaces, and for the purpose of purifying the combustible gases from sooty particles a fine spray of water is injected by a rose. A blast of air directed through tuyeres into the chamber of the glass furnace urges the combustion of the gaseous fuel.

Grants of Provisional Protection for Six Months.

192. Frederick North, Leeds, Yorkshire, "Improvements in processes and apparatus for treating and preparing peat and turf, and the products obtained therefrom."—A communication from Charles Fluery, Bruxelles.

200. Eugen Lucius, Frankfort-on-the-Maine, Germany, "Improvements in the manufacture and production of colours."—Petitions recorded January 23, 1864.

202. John Piddington, Gracechurch-street, London, "Improvements in the manufacture of paper from straw and other analogous vegetable substances."—A communication from Augustus H. Tait, Jersey; Hudons, New Jersey; William H. Holbrook, New York; and A. R. Paton, Brooklyn, Kings, America.

218. George Darlington, Minera, Denbigh, "Improvements in the manufacture of zinc white."

277. Richard Archibald Brooman, Fleet-street, London, "Improvements in the manufacture of glass."—A communication from Mathias Andre Pelletier, Rive de Gier, France.

281. George Hammond, Manchester, and James William Kemp, Salford, Lancashire, "Improvements in the manufacture of illuminating gas, and in apparatus to be employed therein."—Petitions recorded February 2, 1864.

283. Edward Beans, Argyll-street, London, "Improvements in preparing or treating animal charcoal."

Notices to Proceed.

2425. Edward Brown Wilson, Strand, London, "Improvements in the manufacture of iron and other metals, and in the apparatus employed therein, parts of which are applicable for other purposes, where high temperatures are employed, and also for ventilation."—Petition recorded October 3, 1863.

2373. Lucius Henry Norris, Upper Bedford Place, Russell Square, London, "Improvements in the manufacture of India-rubber and gutta-percha compounds."—A communication from Lyman Holme, Rue Vendôme, Paris.—Petition recorded September 26, 1863.

3209. Charles Bolton, Moreton Street, Pimlico, London, "Improvements in apparatus for producing optical illusions, which may be used for dramatic and other entertainments."—Petition recorded December 19, 1863.

58. Bernhard Samuelson, Banbury, Oxford, "An improvement in smelting iron ores."—Petition recorded January 9, 1864.

2374. William Malan, Walpole Street, Deptford, Kent, and William Tice, Downham Road, Islington, London, "Improvements in apparatus for supplying gas to railway-carriages and other moving structures, and in apparatus for manufacturing and holding gas in ships and other vessels, parts of such apparatus being also applicable for manufacturing and holding gas elsewhere."—Petition recorded September 26, 1863.

2383. John Bailey, William Henry Bailey, Salford, Lancashire, and George Henry Blake, Manchester, "Improvements in barometers, gas regulators, and other apparatuses for regulating and indicating the flow and pressure of liquids and fluids."

2699. Samuel Hickling Parkes, Birmingham, Warwickshire, "Improvements in opera glasses, telescopes, microscopes, spectacles, and other optical instruments."—Petition recorded October 31, 1863.

2467. William Lorberg, Wyld's Rents, Bermondsey, Surrey, "Improvements in the manufacture of gas from tar."

2489. Duncan Proudfoot, Glasgow, Lanark, N.B., "Improvements in printing on textile fabrics."

2509. Joseph Place, Hoddlesden, Lancashire, "An improved application of certain schistous or shaley materials to the manufacture and finishing of paper."—Petitions recorded October 13, 1863.

2520. William Jackson Rideout, Farnworth Mills, Bolton, Lancashire, "Improvements in boiling rags and other paper-making materials."—Petitions recorded October 14, 1863.

MISCELLANEOUS.

British Pharmacopœia.—In consequence of the insertion of an abstract of Dr. Redwood's lecture, we omit our article on the Pharmacopœia.

Cavendish Society.—The annual meeting of this Society was held on Tuesday last. We defer any report of the proceedings until the report of the Council is in our hands.

Royal Institution.—Monday, March 7, at two, General Monthly Meeting. Tuesday, March 8, at three, Professor Marshall, "On Animal Life." Thursday, March 10, at three, Professor Marshall "On Animal Life." Friday, March 11, at eight, Rev. W. H. Brookfield "On the Use of Books." Saturday, March 12, at three, Professor Frankland "On the Metallic Elements."

Alkali Act.—The following are the names of gentlemen appointed by the Board of Trade, District Inspectors under the Alkali Works Regulation Act:—

Mr. Brereton Todd,
Mr. Alfred E. Fletcher,
Dr. Charles Blatherwick,
Dr. John Thomas Hobson.

The salary is 400*l.* per annum. Mr. Fletcher, we believe, was a member of the firm Wilson and Fletcher, chemical manufacturers. The names of the other gentlemen are entirely unknown to us.

Young *v.* Fernie.—This is another trial by Mr. Young to establish his exclusive right to the manufacture of paraffine oils and paraffine from bituminous coal. It commenced before Vice-Chancellor Stuart on Monday last. Seven counsel are engaged for the plaintiff, and six for the defendant. There are 200 witnesses to be examined, we are informed; and the trial will probably extend over three weeks. Dr. Hofmann was the first witness, and was under examination three days. We hope to be able to give a brief analysis of the chemical evidence. The issues raised appear to be the same as in the cause of Binney and Co. against the Clydesdale Chemical Company.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

E. B.—Published by Churchill and Sons.

G. A.—The compound is commonly sold by practical chemists.

Dr. Smith, Auburn, Ohio, U.S., is thanked for his communication, but it is altogether unsuited to our columns.

Books Received.—"A Chart," &c. Churchill and Sons.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Researches on the Platinum Metals,** by WOLCOTT GIBBS, *M.D.*

(Continued from vol. vii., page 98.)

THE mass of mixed double chlorides, after the volatilisation of the osmium and the separation of the iron and other impurities by washing with a concentrated and cold solution of chloride of potassium or ammonium, is to be rubbed to fine powder, boiling water added, and the iridium reduced by a dilute solution of nitrite of soda, care being taken not to use more of this salt than is sufficient to convert the iridium salt, $IrCl_2KCl$, into Ir_2Cl_33KCl, and to keep the solution neutral with carbonate of soda. Almost the whole of the chlorplatinate of potassium remains undissolved, while the iridium, rhodium, and ruthenium soluble salts remain in solution. The liquid is to be allowed to cool, filtered, the remaining mass washed with cold water until only the chloroplatinate of potassium remains, and the washings filtered and added to the main solution. If the washings have been carefully performed with small, successive quantities of water, very little platinum is dissolved, and the olive-green solution contains chiefly—

$$Ir_2Cl_33KCl, Rh_2Cl_33KCl, Ru_2Cl_32KCl,$$

and $RuCl_2KCl$ with insignificant quantities of $PtCl_2KCl$.

A solution of chloride of luteocobalt, $6NH_3 \,.\, Co_2Cl_3$, is now to be cautiously added as long as a precipitate is produced; a copious pale buff precipitate is thrown down which settles easily, leaving a yellow or orange-yellow solution containing the luteocobalt salt in small excess. The precipitate is to be washed by decantation, then thrown upon a filter and thoroughly washed with boiling water and afterwards with boiling dilute chlorhydric acid. The filtrate and washings are to be evaporated together on a water-bath to dryness. They contain the whole of the ruthenium and platinum present in the original solution. The mass upon the filter, which has a pale buff colour, consists of the two insoluble double salts—

$$6NH_3 \,.\, Co_2Cl_3 + Ir_2Cl_3, \text{ and } 6NH_3 \,.\, Co_2Cl_3 + Rh_2Cl_3,$$

and is perfectly free from ruthenium and platinum.

This process is based upon the fact that the iridium and rhodium double salts above mentioned are almost absolutely insoluble in boiling water and in boiling dilute chlorhydric acid, while the ruthenium and platinum salts, which have respectively the formulæ—

$$6NH_3 \,.\, Co_2Cl_3 + 3RuCl_2, \text{ and } 6NH_3 \,.\, Co_2Cl_3 + 3PtCl_2,$$

are easily soluble.

Palladium also forms with chloride of luteocobalt a double salt which is easily soluble in dilute chlorhydric acid, and which crystallises from the solution, on cooling, in beautiful orange-yellow, granular crystals. The formula of this salt is—$6NH_3 \,.\, Co_2Cl_3 + 3PdCl$. Any traces of palladium which may have been present in the original mass of double chlorides will therefore be found with the ruthenium and platinum salts. When the mixed chlorides have been thoroughly washed, palladium is never present. The sesquichloride of ruthenium gives no precipitate with solutions of chloride of luteocobalt, and appears not to form a double salt with the chloride of this radical, possibly in consequence of the triacid character of luteocobalt, and the bibasic character of the sesquichloride of ruthenium, the potassium double salt being $Ru_2Cl_3 + 2KCl$. All the sesquichloride of ruthenium present in the mass of mixed chlorides in combination with chloride of potassium will therefore be found in the filtrate from the insoluble iridium and rhodium double salts.

The mass of double salts of iridium and rhodium with luteocobalt, after complete washing, is to be brought into a flask and boiled with a strong solution of caustic potash until ammonia ceases to be given off. With a concentrated solution this may be effected in a short time. On addition of an excess of chlorhydric acid the black powder readily dissolves, giving a solution which contains the double chlorides of iridium and potassium and rhodium and potassium—Ir_2Cl_33KCl, and Rh_2Cl_33KCl, together with chloride of cobalt. The solution is to be evaporated to dryness, and the chloride of cobalt dissolved out by boiling with absolute alcohol. The iridium and rhodium are then to be separated by nitrite of soda and sulphide of sodium or ammonium in the manner already pointed out. The sulphide of rhodium after washing and continued ignition gives pure metallic rhodium.

The filtrate from the iridium and rhodium salts contains a comparatively large quantity of ruthenium in the form of Ru_2Cl_32KCl and $RuCl_2KCl$, together with a trace of the ruthenium and platinum double salts—

$$6NH_3 \,.\, Co_2Cl_3 + 3RuCl_2 \text{ and } 6NH_3 \,.\, Co_2Cl_3 + 3PtCl_2.$$

The solution is to be evaporated nearly to dryness, boiled with a strong solution of caustic potash, and then treated with an excess of chlorhydric acid, which gives the double chlorides—

$$RuCl_2KCl, PtCl_2KCl, \text{ and } Ru_2Cl_22KCl,$$

together with an excess of chloride of potassium and a little chloride of cobalt. This last may easily be removed by alcohol after evaporating the mixed chlorides to dryness. Platinum and ruthenium may then be separated by boiling with nitrite of potash, evaporating to dryness, boiling with dilute chlorhydric acid so as to convert the whole of the ruthenium into $RuCl_2KCl$, neutralising with carbonate of potash, again boiling with nitrite of potash, evaporating to dryness and dissolving out the double nitrite of ruthenium and potash by absolute alcohol. The nitrite of ruthenium and potash may then be treated in the manner already described, and the ruthenium brought into the form of the double salt of mercury and ruthendiamin, from which the pure metal is easily obtained. This method of separating the platinum metals gives excellent results, but is not free from objection. In the first place, it will be remarked that it does not dispense with the employment of the alkaline nitrites, although to some extent it facilitates their use. But the chief objection is found in the necessity of employing very large quantities of chloride of luteocobalt, a salt which is not to be had in commerce, and which must therefore be specially prepared for the occasion.

This difficulty may be in a great measure avoided by employing the chloride of luteocobalt chiefly as an agent for the separation of rhodium from platinum and ruthenium, which may be accomplished in the following manner:—The mass of mixed double chlorides, after the removal of the iron, &c., by washing, is to be rubbed to a fine powder in an unglazed porcelain mortar, and then washed with cold water in small portions at a time until the washings give no sensible reaction for ruthenium, when tested in the manner already described with nitrite of potash and colourless sulphide of ammonium. The washings contain all the ruthenium, as—$RuCl_2KCl$ and Ru_2Cl_22KCl, and all the rhodium, as—Rh_2Cl_33KCl, together with a not inconsiderable proportion of iridium, as—$IrCl_2KCl$, and a much smaller quantity of platinum, as—$PtCl_2KCl$. The iridium in this solution is to be reduced to sesquichloride by the addition of a dilute solution of nitrite of soda with a little carbonate of soda to keep the solution as nearly neutral as possible. A solution of chloride of luteocobalt is then to be added as long as a precipitate is produced, when the whole is to be filtered and the precipitate thoroughly washed, first with boiling water, and afterwards with water containing a little chlorhydric acid. The precipitate on the filter consists chiefly of the rhodium salt—$6NH_3 . Co_2Cl_3 + Rh_2Cl_3$, with a smaller proportion of the corresponding iridium salt. The mixed rhodium and iridium salts are then to be boiled with a solution of caustic potash as long as ammonia is evolved, treated with excess of chlorhydric acid, evaporated to dryness, the chloride of cobalt dissolved out by alcohol, and the iridium and rhodium separated by nitrite of soda and sulphide of ammonium in the manner already pointed out.

The filtrate from the insoluble rhodium and iridium salts contains the ruthenium as $RuCl_2KCl$ and Ru_2Cl_32KCl, together usually with a small quantity of the double salt $6NH_3 . Co_2Cl_3 + 3RuCl_2$ and of $PtCl_2KCl$. The platinum and ruthenium are then to be separated with nitrite of potash and alcohol by the process already described. This method of employing the chloride of luteocobalt is extremely convenient when it is desired to obtain pure ruthenium or rhodium at once from the osmium-iridium.

The presence of a portion of the ruthenium in the form of Ru_2Cl_32KCl in no wise modifies the application of the above process, because this salt gives no double decomposition with a solution of chloride of luteocobalt. As the nitrite of soda employed to reduce the $IrCl_2$ to Ir_2Cl_3 may exercise a reducing action on the Ru_2Cl_3, it will be found advantageous after washing out the $RuCl_2KCl$ and Ru_2Cl_32KCl, to convert the Ru_2Cl_32KCl entirely into $RuCl_2KCl$. This may easily be accomplished by adding a solution of caustic potash in excess, and then passing a current of chlorine gas into the liquid until the odour of hyperruthenic acid is observed. By adding nitric acid in excess, so as to dissolve the black precipitate at first produced, and then evaporating to dryness with an excess of chlorhydric acid, the whole of the ruthenium will be brought into the form of $RuCl_2KCl$.

When a solution of chloride of luteocobalt is added to one containing bichloride of iridium, an insoluble, buff-coloured precipitate is thrown down, consisting of a salt which has the formula—$6NH_3 . Co_2Cl_3 + 3IrCl_2$. When this salt is digested or boiled with an alkaline nitrite, the bichloride of iridium is reduced to sesquichloride, and the salt, $6NH_3 . Co_2Cl_3 + Ir_2Cl_3$ is formed, well characterised by its extreme insolubility. In the presence of a large excess of platinum in the form of $PtCl_2KCl$, it is very difficult to reduce iridium completely from bichloride to sesquichloride, and even in the presence of an alkaline nitrite the chlorplatinate of potassium, after repeated crystallisation, obstinately retains a reddish or deep orange tint, arising from traces of the corresponding iridium salt. The presence of the smallest trace of iridium may be easily detected in the platinum salt by dissolving the whole in boiling water and adding a solution of chlorplatinate of luteocobalt—

$$6NH_3 . Co_2Cl_3 + 3PtCl_2,$$

which precipitates only its equivalent of the corresponding iridium salt. The precipitate is to be filtered off, and digested with a hot solution of nitrite of soda or potash, a small excess of a solution of chloride of luteocobalt added, and the double chloride $6NH . Co_2Cl_3 + Ir_2Cl_2$ thoroughly washed. This process affords a perfectly satisfactory method of separating iridium quantitatively from platinum, and for analytical purposes is more convenient than the separation by an alkaline nitrite and sulphide already described. The quantitative separation of iridium from ruthenium and palladium is also readily effected by the chloride of luteocobalt, as well as the separation of rhodium from platinum, ruthenium, and palladium. I shall return to this subject in treating of the metals of this group separately, and will then point out another method of using the chloride of luteocobalt, which is also deserving of attention.

The separation of the metals contained in the mass of sulphides precipitated in the separation of iridium from rhodium, ruthenium, and platinum, by the method already pointed out, may be very conveniently effected in the following manner:—The mixed sulphides are to be dried, separated from the filter, and intimately mixed in a mortar with an equal weight of a mixture of equal parts of carbonate and nitrate of baryta. The filter is to be burned, and the ash mixed with the sulphides and baryta salts. The mixture is then to be ignited in a porcelain or earthen crucible for an hour at a full red heat, and the mass which does not fuse, treated with a strong chlorhydric acid, which dissolves the oxides of rhodium, ruthenium, and platinum completely, leaving only sulphate of baryta. The baryta is then to be precipitated by sulphuric acid, an excess of which must be carefully avoided, and then a solution of chloride of luteocobalt added as long as a precipitate is formed. The double chloride of rhodium and luteocobalt may then be filtered off and thoroughly washed with boiling water acidulated with chlorhydric acid. By igniting this salt and dissolving the chloride of cobalt out from the mass, pure metallic rhodium remains. The platinum and ruthenium in the filtrate may then be separated by means of nitrite of potash and alcohol in the manner already described.

This method of treating the sulphides requires only a small quantity of chloride of luteocobalt, is extremely easy of application, and is much shorter than the first method which I have described. Taken in connexion with the process for separating iridium by means of nitrite of soda and sulphide of sodium, it furnishes an easy and complete solution of the problem of the qualitative or quantitative separation of the metals of this group, osmium only being determined by the loss.—*American Journal of Science.*

(To be continued.)

TECHNICAL CHEMISTRY.

On the Adulteration of Beer with Picrotoxine,

by M. Schmidt.

The attention of the police having been drawn to the importation to St. Petersburgh of large quantities of coculus indicus, it was found that this berry was used to adulterate certain drinks, but especially beer. Wishing to assure himself of the truth of this statement, M. Schmidt endeavoured to isolate the picrotoxine, and believes he has succeeded by the following rather complicated process:—After evaporating the beer in a water-bath to a syrupy consistence, he mixed it with tepid water till it was perfectly liquid, so as to bring the volume to a third of the liquid used; he then heated and shook it up with animal charcoal. After standing several hours, he filtered, and then heated it slightly, precipitated by basic acetate of lead, and again filtered.

The liquid should be of a yellow wine colour; if not, it must be re-filtered through animal charcoal. Then from five to ten cube centimetres of amylic alcohol are to be added to the liquid, which should be briskly shaken several times at intervals. After twenty-four hours, the amylic alcohol collects on the surface, containing the greater part of the picrotoxine. The remainder is subsequently eliminated by fresh treatment with amylic alcohol. Having collected the limpid layers of this alcohol, they are left to evaporate spontaneously. On the sides of the capsule a yellowish ring forms, and this contains the picrotoxine mixed with resinous substances.

Such is the first phase of the process; the second, and yet more delicate, phase has for its object the isolation of the picrotoxine. The resinous product is first dissolved in weak alcohol, evaporated to dryness, then recovered by a little boiling water containing a small quantity of sulphuric acid, afterwards boiled to expel any volatile matter, then a little animal black is added to eliminate all extractive and resinous matter, and lastly it is filtered. The inodorous liquid is next evaporated, and when a fresh bitter taste becomes developed it is to be shaken up with ether, which re-dissolves the picrotoxine, and collects into a distinct layer on the surface of the liquid. On again treating with ether, the whole of the picrotoxine is eliminated; finally, the etherial liquids are mixed, a little alcohol is added, and the whole is evaporated. The white or yellowish ring formed consists of picrotoxine, which then has only to be dissolved in alcohol to furnish the immediate principle in the form of well-defined crystals.

But to obtain these crystals the solution must be free from resinous substances. If not free, and if, for instance, the etherial solution is of a yellow colour, it must be recovered with water, and treated by charcoal, as above described.

The latter, it is true, retains traces of picrotoxine, which can be taken up by means of diluted and warm spirits of wine.

By these means the author was enabled to detect 0·04 of picrotoxine in a bottle of beer which had been adulterated with eight grains of indian berry.

Picrotoxine has a pronounced bitter flavour; it is in the form of clearly-defined crystals, which form very readily in ordinary alcohol, but not at all in ether or amylic alcohol. If, on the point of a penknife, we take a little picrotoxine, and place it on a highly-coloured plate of glass, then add alcohol to dissolve it, and leave it to evaporate slowly, silky crystals will, after a time, form, and group in tufts; to effect this, the liquid must be sufficiently diluted.

Picrotoxine reduces the oxide of copper in Barreswil's liquid.* Heated, it forms a yellow transparent mass, resembling caramel, then it becomes charred. Its reaction is neutral; sulphuric acid becomes yellow while dissolving it, and when hot destroys it. Weak sulphuric acid has no action on it, neither have nitric, tartaric, nor acetic acids, when diluted with water, nor ammonia; very soluble in alcohol, ether, amylic alcohol, and chloroform. Slightly soluble in fatty oils and petroleum; hot water dissolves picrotoxine better than cold; and the best crystals are formed in ordinary alcohol.—*Journal de Pharmacie et de Chemie*, xliii., 170. 63.

Note on Sponge, by R. J. Rutter, *Analytical Chemist.*

When well-washed Turkey sponge is immersed in a nitro-hydrochloric acid bath (nitro-hydrochloric acid, ʒiij.; water, ʒv) for half a minute, then lightly pressed and removed into a sulphuric acid bath (acid sulph. dil., Ph. L., 1851) for fifteen minutes; and then plunged into a solution of ammonia (liq. ammonia ·880, ʒij.; water, ℥j.), and allowed to digest for five or ten minutes, a beautiful orange-yellow colour will be produced, which is very permanent. The texture of the sponge is not at all injured by this process, if it is not digested longer than half a minute in the nitro-hydrochloric acid bath; it wears equally as well as the ordinary sponge, and is much more saleable.

I believe the colour to be due to the action of the acid on the iodine and bromine contained in the sponge. In the first instance, iodine and nitro-hydrobromic acids being produced, the iodine is converted by the sulphuric into iodo-sulphuric acid, and this, in turn, is decomposed by the ammonia, iodine and a small portion of bromine being liberated.

The ammonia bath, after the immersion of the sponge, contains sulphate of ammonia, and also a small portion of nitrate and hydrochlorate.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

(*Continued from page* 87.)

Aconitum.—The Galenical preparations of this important plant will be noticed in their proper places. The alkaloid *Aconitia* is the only thing we shall here allude to. In the directions for the preparation of the alkaloid we have the first example of something like a manufacturing process. The Pharmacopœia, in general, deals with grains and ounces, and it is almost startling to read the directions which begin. Take of aconite root, in coarse powder, *fourteen pounds.* The process which follows is altogether unexceptionable. It was, in fact, most liberally placed at the disposal of the Pharmacopœia committee by the eminent makers of this alkaloid, Messrs. Hopkin and Williams; and with careful manipulation yields a perfectly pure aconitine. The process has already been published in our columns, and will be found at page 200, vol. viii.

It is unfortunate that so expensive an article as aconitine cannot be obtained in a crystalline state, so that its purity may be determined by its physical character. It is described in the Pharmacopœia as "a white and usually amorphous solid," which will also accurately describe the worthless and almost inert aconitine imported from Germany, against which we may once more caution our readers.

Aconitine is very seldom seen perfectly white, but is usually of a light-brown colour. A loss is sustained by repeated solution and treatment with animal charcoal, which is a matter of some consequence to the manufacturer.

Aconite root deserves more attention than it has yet received from chemists and pharmaceutists. The nature and properties of the resinous matter soluble in alcohol, but not in ether, which is separated in the above process, have not yet, so far as we know, been investigated, and might well repay examination.

Æther.—The London College, in 1851, gave no directions for the manufacture. In the British Pharmacopœia, the process of the Edinburgh College has been adopted,

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* On this reaction the author founds a process for distinguishing picrotoxine from alkaloids. However, the basis of this process is wrong, if it be true, as M. Kosmann affirms, that alkaloids are themselves glucosides.

and an ether differing slightly from that described in 1851 is directed to be made. It is completely dehydrated, but may contain about 8 per cent. by volume of alcohol. The density is now ·735 instead of ·750.

We shall pass over Spirit of Nitrous Ether for the present, having some experiments on the subject to complete. By *Alumen* the Pharmacopœia intends the double sulphate of alumina and potash, which we fear will seldom be obtained. Practically, this is of very little importance. If, in making alumen exsiccatum, care be taken to carry the heat only so far as is necessary to get rid of the water of crystallisation, the resulting "burnt alum" will be much the same thing in both ammonia and potash alum; but if the heat is carried much further with ammonia alum, the sulphate of ammonia decomposes and is lost, and a residue of sulphate of alumina only remains.

Liquor Ammoniæ Acetatis.—This solution is now directed to be made by neutralising the strong solution of ammonia with acetic acid, and is, moreover, a much stronger solution than was ordered in preceding Pharmacopœias. It is difficult to guess the reason for the change, unless the object of the Committee was to imitate more closely the original Spirit of Mindererus, which was made by neutralising strong vinegar with real Spirit of Hartshorn, and must have been a nasty compound. However that may be, the liquor ammoniæ acetatis of the British Pharmacopœia will differ essentially from that of the London, Dublin, and Edinburgh Pharmacopœias. It is five times stronger than the London preparation, and six times stronger than the Dublin and Edinburgh. Perhaps the reason for making it by means of a solution of ammonia instead of the sesquicarbonate was a supposed difficulty in ascertaining the exact point of saturation, in consequence of the carbonic acid. The new medicine, though probably as efficacious as the old, will be a vapid, tasteless liquor, very different to the bright, sparkling fluid, when freshly prepared, obtained in the old way.

This is one of the preparations which will give pharmaceutists some trouble with prescriptions. Nobody is likely to be poisoned if the new liquor is put when the old is intended, nor is much injury likely to accrue from the reverse substitution. Dispensers, however, are bound to consult the wishes of prescribers, and will in general be guided by the dose ordered, which they may expect to be about one-fifth of what was formerly prescribed under the same name.

Ammoniæ Benzoas.—The Pharmacopœia directions for the preparation of this salt may be followed with safety. An excess of ammonia is ordered, but it will be well to add a small quantity occasionally as the evaporation proceeds to prevent the formation of the less soluble acid salt. The crystals must be dried at a very low temperature, since the normal benzoate is so easily converted into the acid salt.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 3, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, and the several donations to the Society's library acknowledged by a vote of thanks, Mr. Benjamin E. R. Newlands was admitted a Fellow of the Society, and Mr. Edward Baines, of Toronto, Canada West, and Mr. William Ritchie, jun., were duly elected by ballot.

The President, in announcing the programme relative to the changes in the Council which would be proposed for adoption at the anniversary meeting on the 30th instant, mentioned the name of Mr. C. Greville Williams in substitution for Mr. Way, the other members of the Council remaining as already enumerated in our last report. The President took occasion, also, to mention that the researches on the formation of malonic and succinic acids, which, at the period of the Society's last meeting, were being pursued independently by Professor Kolbe and Dr. Hugo Müller, were now to be proceeded with by these gentlemen conjointly.

An interesting paper, "*On the Non-Metallic Impurities of Refined Copper,*" was read by Professor F. A. Abel. The author commenced by referring to the experiments which had already been made by Berthier and Karsten, and more recently by Percy, Dick, and Matthiessen, for the purpose of determining the influence of various impurities upon the working qualities of copper. It was manifest that the *metallic* impurities always exerted a considerable influence, and now that the system of analysis had been so far perfected as to show the smallest traces of the commonly occurring metals, and to indicate their amount, there appeared but little room for improvement to be effected in this branch of the analytical examination. Some account of the metals usually found occurring in the commercial qualities of copper had been given in a paper recently presented to the Society by the author, in conjunction with Mr. F. Field. The primary object of the present communication was to arrive, if possible, at a more accurate conclusion regarding the existence and amount of the several *non-metallic elements* which occurred, or were liable to be found, in the various qualities of refined copper met with in commerce, and the experiments described were directed especially to the quantitative estimation of oxygen and sulphur. Many samples of ingot copper from Swansea, and other specimens prepared for the purposes of this investigation from chemically pure copper, were examined.

Determination of the Amount of Oxygen in Copper.—This constituent is so generally present, and is known to exert so marked an influence upon the quality of the copper that it became extremely important to examine critically the processes by which the amount of this element in any given sample has usually been determined. The oxidisable nature of copper at high temperatures, and the known fact of suboxide of copper being soluble to a considerable extent in the fused metal, made it almost impossible that samples resulting from the ordinary metallurgical treatment should be free from oxygen; and the investigation was, therefore, commenced at this point. The method which had been usually followed in determining the amount of oxygen was that of heating the finely-divided metal in a current of pure and dry hydrogen, and collecting in a weighed chloride of calcium tube the whole of the water formed. This process was used by Dick in his interesting researches made in 1856; but the difficulties were at that time allowed to be such as to introduce the chance of error, and the results were no doubt in excess of the true amount, and were seldom concordant in the different operations made upon the same sample. Another process was that of determining the loss of weight sustained by melting the copper under charcoal and in an atmosphere of pure hydrogen; whilst a third suggestion was that of converting the copper into protoxide in the wet way, and then comparing the amount of copper deduced from the weight of the oxide obtained with that of the metal originally dissolved. Neither of these processes were considered by Dick as affording more than approximative results; and the last was far from being satisfactory. Mr. Abel had instituted a very complete series of experiments for the purpose of ascertaining the degree of reliance which might be place in the method of reduction by hydrogen; but it was found to be altogether untrustworthy, chiefly from the circumstance that it was impossible to exclude air from the apparatus, or to drive out that portion which ordinarily occupies the cavities in the metal assayed; whilst, on the other hand, it was found that but little dependence could be placed on the total expulsion as water of the whole of the oxygen contained in the metal operated upon. The current of hydrogen gas, after passing over heated copper wire in a preliminary tube, and thence through efficient drying arrangements, was passed, in some instances, for fifteen and even twenty hours through the apparatus before the tube containing the copper to be experimented upon was heated; and every precaution was taken in properly securing the important joints of the chloride of calcium or phosphoric acid tube, and the glass combustion tube in which the sample of copper under analysis was contained. Still no reliable results could be obtained in this manner. Much better success was, however, obtained by using a process which the author next proceeded to describe. It is well known that pure copper decomposes neutral nitrate of silver with formation of an equivalent amount of nitrate of copper, the silver being deposited; but if suboxide of copper be contained in the sample of metal operated upon, a secondary reaction will take place, resulting in the production of an insoluble basic nitrate of copper. Therefore, when copper is converted into nitrate by means of the neutral silver-salt, any suboxide which it may contain is converted by one equivalent of nitrate of silver into two equivalents of protoxide; the excess of base thus presented to the nitric acid induces the formation of an insoluble basic salt of copper, and the basicity of the total amount of this product obtained in the reaction is directly proportionate to the quantity of suboxide contained in the sample of metal under examination; and consequently the volume of acid required to neutralise such basic salt of copper will at once indicate the amount of oxygen existing in the original specimen. In applying these facts to the determination of oxygen in copper, it is simply necessary to convert a known weight of the metal into nitrate by digesting in an aqueous solution of neutral nitrate of silver, then to collect the mixed particles of reduced silver and basic nitrate of copper, wash them on a filter, and digest them for about half an hour in the cold with a known volume of standard sulphuric acid (one part of oil of vitriol diluted with about one hundred parts of water) until the whole of the copper salt has been dissolved. In order now to determine the proportion of acid which has become neutralised in this operation, a standard solution of carbonate of soda (containing 930 grains of the dry salt dissolved in a gallon of water) is added until a precipitate of carbonate or, rather, basic sulphate of copper begins to appear. Calculation gives at once, from the amount of acid which has been neutralised by the act of dissolving the basic nitrate of copper, the proportion of oxygen, or suboxide, contained in the original sample of copper. The author stated that it was not necessary to wait for the entire solution of the specimen operated upon, but that as soon as 100 grains, or about that quantity, had been dissolved away by the action of the nitrate of silver, the remaining portion of metal could be removed from the solution, and its loss of weight noted. Several determinations were made in succession upon the same lump of copper, and the results showed a close agreement in every case, but it was occasionally remarked that the top of an ingot contained somewhat more oxygen than the lower portions, this difference increasing with the amount of oxide contained in the specimen. In the examination of a series of ingots of Kapunda copper, it was invariably found that the physical structure of the metal was to some extent influenced by the oxygen contained therein, and particularly it was noticed that ingots which exhibited depressions along the centre of their upper surfaces contained more oxygen than others which appeared to be flat. This brand of copper had been selected on account of its general purity and freedom, especially from extraneous metals. The amount of oxygen in the ingots was found to vary between the limits of ·12 and ·33 per cent. By prolonged fusion of ordinary copper in a closed crucible, under a layer of charcoal, and allowing the mass of metal to cool out of contact with air, Mr. Abel had succeeded in preparing samples of copper which were entirely free from oxygen, and, tested by the analytical method already described, gave nothing but pure reduced silver. The physical characters of such copper were great toughness, combined with highly crystalline structure, and showing cavities of contraction upon the upper surface, which was always remarkably brilliant. But if the same metal were removed from the furnace and cooled with free exposure to air, the structure became highly vescicular, and excrescences were formed upon the upper surfaces. In proceeding to describe the results obtained in the analysis of a series of samples in different stages of manufacture, which were supplied by the Hafod Works, near Swansea, Mr. Abel gave the following numbers as representing the average proportion of oxygen contained in these ingots:—

	Oxygen per Cent.
"Dry" copper	0·42
Do. (another specimen) .	0·50
"Half-poled" copper . . .	0·20
"Tough pitch" copper . . .	0·03
"Overpoled" copper	0·03

The coincidence observed in the proportion of oxygen contained in the last two kinds of copper led to the institution of several experiments, in order to confirm their accuracy. It appears, however, probable that copper in the overpoled condition cannot be cast in air without absorbing a small amount of oxygen. Again, with regard to the amount obtained in the analysis of "dry" copper, it was observed that the maximum fell considerably short of that mentioned in the publications of Percy and Dick. The author had consequently been led to make further experiments bearing directly on this point; and by fusing copper in contact with air, or projecting black oxide of copper into the crucible containing the melted metal, it was considered that samples of dry copper perfectly saturated with oxygen were obtained. These gave on analysis amounts practically identical with those already mentioned. (Mr. Abel described his results, not only calculated for the amount of oxygen, but also as being equivalent to the very much larger amount of suboxide of copper, which was stated in all cases. Thus, the 0·5 per cent. of oxygen, observed in the case of dry copper, corresponds to nearly 4·5 per cent. of suboxide of copper. This amount was stated to be lower by one-half than the results arrived at by A. Dick in estimating the proportion of suboxide by the method of reduction in a current of hydrogen.) With regard to the existence of carbon in commercial samples of copper, Mr. Abel described the attempts he had made to detect the presence of this element, and to combine directly carbon and copper. There was no evidence, however, of any combination being formed even when melted copper was kept for a long time in contact with wood charcoal. One of the methods adopted in searching for carbon in copper consisted in acting upon the metal with nitrate of silver, and treating the reduced silver with mercury. Alten and Kapunda copper were used in these trials, it being important to exclude the presence of foreign metals. In the course of making the experiments connected with the identification of carbon in Alten copper, it was discovered incidentally that this kind of copper contained a trace of selenium. This element was detected in the sublimate formed on heating a small quantity of black insoluble residue, which was left on dissolving the metal in perchloride of iron. The method ultimately adopted for its detection was that of adding a little carbonate of soda to the nitric acid solution of 1000 grains of the copper; the whole of the selenium was carried down in this first portion of precipitate, and could be separated by dissolving in hydrochloric acid and boiling with sulphurous acid. The utmost amount of selenium obtained did not exceed ·003 per cent. There was no doubt that sulphur and oxygen co-existed in samples of refined copper; and when experiments were made for the purpose of determining the amount of the latter by reduction with hydrogen, a small quantity of the sulphuretted compound of that element was invariably produced. The separation of the whole of the sulphur in this manner was attended with difficulty, for even when the metal was employed in the state of filings a long time was required for the complete elimination of this constituent. Not more than ·005 per cent. of sulphur was detected in a sample of copper heated for forty-eight hours in a current of hydrogen, the products being in this case collected in the form of sulphide of lead. Phosphorus and nitrogen had been looked for, but neither of these elements had ever been detected. The mode of examination consisted in partially precipitating the nitric solution of the copper with carbonate of soda, as in the case of selenium, then decomposing the precipitate by sulphuretted hydrogen, and looking for phosphoric acid in solution by the ordinary tests. The metal was digested in a mixture of sulphuric acid and bichromate of potassa, with the view of searching for nitrogen, which it was believed would have been eliminated as gas. None was given off. The author alluded to the occasional existence in copper of small portions of enclosed slag, but, excepting in this form, there was no reason to expect the existence of silicon as an impurity, and in the course of his experiments none had ever been found. The lecturer took occasion to acknowledge the assistance he had received during the prosecution of these researches from Mr. E. O. Brown and Mr. F. H. Hobler, both of whom had contributed very materially to the elaboration of the analytical details.

The discussion which followed the reading of the above paper, and the report of Dr. Frankland's communication "*On the Synthesis of Leucic Acid,*" will be given in our next. The President, in adjourning the meeting until the 17th inst., stated that a special lecture, "*On the Organic Peroxides Theoretically Considered,*" would then be delivered by Sir Benjamin C. Brodie, F.R.S.

PHARMACEUTICAL SOCIETY.

Wednesday, March 2.

Mr. Sandford, *President, in the Chair.*

Mr. J. Robbins read a paper on "*Oxygennesis, for the Instantaneous Production of Pure Oxygen without Heat.*" From the time of the discovery of oxygen to the present, perhaps no subject has so much engaged the attention of chemists as the production of it at a cost sufficiently low to be employed in the arts, for the reduction of metals and other operations requiring a high temperature, and also for the purposes of illumination, the light obtained by it vieing in splendour with the sun's rays. This desirable object has yet to be accomplished, and may be regarded as a prize to be won by some future happy discoverer. It seems surprising, since Nature has provided us so bountifully with this substance, and presented it in such a variety of combinations, that, up to the present time, there should be no known method of separating, except at such a cost which excludes it for the purposes just enumerated.

In Gmelin's "Chemistry" six processes are given for the production of oxygen:—

1st. By heating chlorate of potash to low redness. As this process is slow and tedious, a small quantity of oxide manganese is usually mixed with the salt, which greatly facilitates the decomposition, and the evolution of gas is both rapid and abundant. According to the authority just named, manganese is often mixed with carbonaceous matter, which passes over as carbonic acid, but another impurity I may mention is the presence of chlorine, which, I believe, may always be detected when oxygen is obtained by this method.

2nd. By ignition of red oxide mercury. The presence of hyponitric acid may be feared in oxygen so obtained.

3rd. By strong ignition of oxide manganese.

4th. By heating manganese with an equal weight of oil of vitriol.

5th. By ignition of nitrate of potash. This salt when heated above its melting point is converted by the loss of two equivalents of oxygen into nitrite of potash; on a further increase of temperature both nitrogen and oxygen pass off, consequently the product is always contaminated with nitrogen, which increases as the action proceeds.

6th. By the action of sulphuric acid on bichromate of potash. Three parts bichromate potash and four parts sulphuric acid are heated together in a capacious retort. An evolution of oxygen gas easy to regulate is the result. In this experiment we might congratulate ourselves if the process is conducted to the end without a fracture of the retort.

Of the six processes just described, two only are now used—viz., chlorate of potash with or without manganese, and manganese alone. More recently other processes have been recommended, one of which, by heating together nitrate of soda and oxide of zinc, has been patented. From this mixture oxygen is said to be produced at a cheaper rate than by any other method at present known. Unfortunately for the value of this discovery the product is contaminated with a considerable per-centage of nitrogen. M. Kuhlman, of Lille, discovered and published an ingenious and beautiful process for the production of oxygen by means of baryta. He found that by passing a current of common air through caustic baryta heated to dull redness, peroxide of barium was formed, which, on an increase of temperature, is resolved into oxygen gas and caustic baryta; the latter ready again to perform its part in a similar operation. The idea naturally suggested itself that the means were now at hand for getting oxygen from the atmosphere in any quantity at a small cost. This method, although so promising, has been for the present abandoned; it was found that after a few operations, either from a molecular change, or from the silica or other impurities, a sort of glass or fusion resulted on the surface, the baryta then refusing to act again.

We now come to the consideration of the new method for the generation of oxygen recently introduced by myself. The process or the compound employed in it has been named *oxygennesis.* It will have doubtless been observed by you that in all the processes hitherto known a high temperature is necessary, and until that point is reached, no product whatever is obtained; this fact we may consider as the chief difficulty experienced in the preparation of oxygen, and more especially so when sulphuric acid is used. If, for example, by the mere addition of sulphuric acid to bichromate of potash in the cold, we could get the same results which are obtained by the application of heat, this process, instead of being thrust in the rear, would have taken front rank.

Oxygennesis, therefore, stands alone as a novel and the only mode we possess for producing oxygen without the application of heat. The mode of using this compound is extremely simple. We have only to take some of this powder, place it in a glass flask or bottle provided with an exit tube, pour on any of the dilute mineral acids, and we have immediately oxygen evolved in a similar way, and with as much facility, as hydrogen is obtained from zinc or carbonic acid from a carbonate.

The composition of this compound is extremely simple, merely peroxide of barium, and bichromate potash. Not so the chemical changes resulting from the addition of an acid. Peroxide of barium on addition of sulphuric acid, is resolved into sulphate of baryta and peroxide of hydrogen, and it is from this sometimes so-called oxygenated water we get this curious and interesting chemical reaction. Whenever peroxide of hydrogen and chromic acid are brought in contact with each other, instantaneous decomposition is the result, the chromic acid is reduced to sequioxide of chromium, and the peroxide of hydrogen to water; at the same time pure oxygen derived from both those substances is disengaged. The theory of this very interesting reaction is not, I believe, well understood, and I know only one way of explaining it, that is, on the ozone and antozone theory of Brodie. According to that theory, oxygen exists in three different states or conditions, viz., ozone, antozone, and ordinary oxygen, and whenever ozone and antozone (which may both be considered more or less active) are brought together, they unite and neutralise each other, as it were forming passive or common oxygen.

To return to the composition of the powder, we are not compelled to use precisely those ingredients mentioned, but may substitute analagous compounds. Peroxide of barium might be replaced by any other peroxide capable of forming binoxide of hydrogen, of which there are several—peroxides potassium, sodium, strontium, and calcium, but all these at the present time are practically useless, peroxide of barium being the only one that can be easily and cheaply prepared. Bichromate of potash may be substituted by manganate or permanganate of potash, binoxide of manganese or binoxide of lead; the cost of the two first-mentioned forbids their present use, and the one selected is by far preferable to the others. With regard to the acids, either of the mineral class will do, but I prefer a mixture of dilute sulphuric and hydrochloric acids.

The next question demanding our notice is, in a commercial point of view, a most important one; however much this method may be admired for its simplicity, and the ease with which the operation may be conducted, its ultimate success or failure must depend on its cost. Can the oxygennesis, therefore, be manufactured and sold at a price sufficiently low to make it an article of commerce? I believe it can be, and be made available for all purposes wherever oxygen is required to the extent of some gallons. One of the ingredients of this compound, peroxide of barium, has never yet been produced and sold as a commercial article, and from the trouble of making a small quantity, but few even practical chemists care to prepare it for themselves. It can hardly, therefore, be expected that a compound of this nature can at once be manufactured and sold at a price it must ultimately be reduced to, if extensively used and produced in quantity. 5s. per pound, the price hitherto charged, would, I admit, be a barrier to its general adoption; but I am happy to say we have now made the necessary arrangements to lessen the cost of production, and have at the same time reduced the price.

Some of the baryta compounds are found abundantly in nature, and are but of small value in the market, but up to the present time but few uses have been made of them; they now promise a much more extensive application. Mr. Kuhlman has, perhaps, done more than any one else to develope their uses and value in the arts, and in the Chemical News, November 28, 1863, will be found some interesting extracts relating to them from Dr. Hofmann's report on chemical products and processes of the International Exhibition.

I shall trespass a little further on your time to make a few remarks on one of the various applications of oxygen, which may be of some interest to the medical profession and to pharmaceutical chemists. I mean the employment of that body as a therapeutic agent by inhalation. For that purpose this ready method for producing the gas promises to be of great value. Towards the end of the last and the beginning of the present century, vital air, as oxygen was often and not inappropriately called, was used largely in this country and on the Continent. In this country we find the names of Drs. Beddoes, Hill, Thornton, and other physicians. Dr. Hill used it for more than twenty-five years, and Dr. Thornton was quite eminent for his successful application of it. At the present time the desire by medical men for the administration of oxygen has revived both here and abroad. Two papers have recently been read, to be followed by others on the same subject, before the Academy of Sciences at Paris, by Messrs. Demarquay and Leconte. The experiments and observations of those gentlemen appear to have been very numerous and carefully made both on animals and on man, in disease and in health, and the conclusion they arrive at is that oxygen is a valuable curative agent. If so good, then, as a remedy when its value was once known, what caused it to become and continue so long neglected? The explanation is, I think, not difficult. In the first place, when this body was discovered, too much was expected from it. The first *furore* for its employment arose from the simple experiment which showed its power of rekindling an expiring match, and as oxygen is the essential element of our existence, it was supposed it might, in a similar way, rekindle the expiring vital spark. The more imaginative were elated at what they considered a discovery, so long dreamt of and so earnestly sought after by the alchemist. But oxygen is not the elixir vitæ. It will not restore grey hair to its original colour, nor make an old man young. The difficulties and expense attending its administration may also be considered other reasons for its non-employment. Of what use was it for a medical man to order that which the patient could not get supplied? A physician, therefore, having faith in the remedy, was compelled to lay himself out especially for it, become an oxygen doctor, and prepare and administer the remedy himself. These difficulties now no longer exist.

We have on the table an oxygen inhaler and generator, made according to the suggestions of Dr. Richardson. The generation of the gas is by this method so easy and so simple that patients can prepare their own dose, or, if need be, the nurse after one lesson can as well undertake the operation as any other duty she may be required to perform.

Physicians who may wish to employ this remedy may now prescribe it with no more hesitation than they would prescribe a black draught or a calomel pill.

Dr. Squire wished to inquire whether Mr. Robbins' invention had not been patented; if so, he doubted the value of the patent, for Professor Brodie had pointed out in 1851, that when peroxide of barium was treated with an acid solution of bichromate of potash oxygen was evolved with great regularity. Faraday had mentioned the same thing in one of his lectures on ozone at the Royal Institution. Dr. Squire also objected to the name oxygennesis, and thought it ought rather to be called oxyexodus, as the oxygen was eliminated, not created.

Mr. C. H. Wood said that the reactions of peroxide of barium, and bichromate or permanganate of potash were well known as scientific facts, but did not consider that that affected the value of Mr. Robbins' patent. The great objection to Mr. Robbins' process was the cost of the oxygen, and he was glad to hear that this was likely to be reduced. He did not consider that the process was easier than that for obtaining oxygen from chlorate of potash and manganese; indeed, he thought the latter the easier operation. He wished to know how Mr. Robbins decided that oxygen from chlorate of potash and manganese was contaminated with chlorine, and not by ozone. The late Mr. Witt had shown that oxygen obtained in this way always contained a variable proportion of ozone. He (Mr. Wood) did not consider ozone objectionable for inhalation, for he thought that whatever good was effected by oxygen when inhaled, must be due to the ozone which gave active properties to oxygen.

Professor Redwood said that Mr. Crace Calvert had pointed out that oxygen from chlorate of potash and peroxide of manganese always contained chlorine or an oxide of it, and he did not think that the gas from this source was fit to administer. He freely gave his testimony to the value of the process Mr. Robbins had introduced. The process was certainly easy, though it was not calculated for chemists, but would answer well when oxygen was wanted for medical purposes.

Mr. Robbins, in reply, said that he was not aware of Mr. Brodie's experiments, and had not heard of them, although he had spoken to many chemists on the subject. He considered it a great boon to be able to get oxygen by a cold process, and, at all events, still considered the application new. Authorities differed as to the value of oxygen as a curative agent, but the most recent experiments of Demarquay and Leconte seemed to prove that it possessed great remedial power. Under these circumstances it was well to have a means of procuring oxygen as easily as making a cup of tea. With regard to Mr. Wood's doubt about the presence of ozone instead of chlorine, he might say that, in conjunction with Mr. Brown, now of the War Department, he had examined many specimens of oxygen obtained from the chlorate and manganese for ozone, but in all cases found chlorine instead. In his (Mr. Robbins') process the oxygen was well washed.

Mr. Wood said that washing would not remove ozone.

Mr. Robbins replied that Faraday had showed that ozone could be removed by washing, and he himself had found ozone made by means of phosphorus in the ordinary way disappear after shaking with water well for an hour.

The Chairman said he considered Mr. Robbins' an elegant way of procuring oxygen for medical purposes, which had the recommendation of cheapness when the oxygen was considered as medicine.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 9, 1864.

E. W. Binney, *F.R.S., F.G.S., President, in the Chair.*

George Harris, Esq., Barrister-at-Law, was elected an ordinary member.

Professor Roscoe exhibited the light emitted by burning a portion of a fine specimen of pure magnesium wire 1 mm. in diameter and 10 feet long, which had been manufactured by Mr. Sondstadt. Professor Roscoe remarked that it afforded him great pleasure to be able to state that a suggestion made by Professor Bunsen and himself in their photochemical researches, and printed in the *Philosophical Transactions* for 1859, page 922, was about to be practically adopted. Mr. Sondstadt is now commencing to manufacture the metal magnesium on the large scale, and the first important application of the metal is the employment of burning magnesium wire as an illuminating agent, especially for photographic purposes. In the researches above mentioned, Professor Bunsen and the speaker had examined the photochemical action of the sun compared with that of a terrestrial source of light, and for the purpose of this comparison they chose the light evolved by the combustion of magnesium wire. They showed that a burning surface of magnesium wire which, seen from a point at the sea's level, has an apparent magnitude equal to that of the sun, effects on that point the same chemical action as the sun would do when shining from a cloudless sky at a height of 9° 53′ above the horizon. On comparing the chemical with the visible brightness of these two sources of light it was found that the brightness of the sun's disc as measured by the eye when the sun's zenith distance was 67° 22′, is 524·7 times as great as that of the burning magnesium wire; whilst, at the same zenith-distance, the chemical brightness of the sun is only 36·6 times as great. Hence the value of this light as a source of the chemically active rays for photographic purposes becomes at once apparent. The extract from the memoir referred to is as follows:—"The steady and equable light evolved by magnesium wire burning in the air, and the immense chemical action thus produced, render this source of light valuable as a simple means of obtaining a given amount of illumination expressed in terms of our measurement of light. . . . The combustion of magnesium constitutes so definite and simple a source of light for the purpose of photochemical measurement, that the wide distribution of this metal becomes desirable. The application of this metal as a source of light may even become of technical importance. A burning magnesium wire of the thickness 0·297 millimetre evolves, according to a measurement we have made, as much light as seventy-four stearine candles of which five go to the pound. If this light lasted one minute, 0·987 metre of wire, weighing 0·1204 grm., would be burnt. In order to produce a light equal to seventy-four candles burning for ten hours, whereby about 20 lbs. of stearine is consumed, 72·2 grms. of magnesium would be required. The magnesium wire can be easily prepared by forcing out the metal from a heated steel press having a fine opening at bottom; this wire might be rolled up in coils on a spindle, which could be made to revolve by clockwork, and thus the end of the wire, guided by passing through a groove or between rollers, could be continually pushed forward into a gas or spirit-lamp flame in which it would burn." Professor Roscoe stated that great credit was due to Mr. Sondstadt for the able manner in which he had brought the difficult subject of the metallurgy of magnesium into the present satisfactory position, and expressed his opinion that, even for photographic purposes, the application of the metal will prove most important. Mr. Brothers, Mr. Parry, and other photographers present, corroborated Dr. Roscoe's opinion respecting the value of such a source of light for photography. Since the meeting Mr. Brothers made an experiment upon the magnesium light, which he reports as follows:—"The result of an experiment I have just tried is, that in fifty seconds with the magnesium light I have obtained a good negative copy of an engraving—the copy being made in a darkened room. Another copy was made in the usual way in daylight, and in fifty seconds the result was about equal to the negative taken by the artificial light. The sun was shining, but there was a good deal of fog in the atmosphere."

A paper was read, entitled "*On the Tensile Strength of Cotton, as affected by various Chemical Treatments,*" by Mr. Charles O'Neill, F.C.S. The author has given a great number of experiments upon the subject, made in order to elucidate some important practical and scientific points not hitherto much worked upon. By means of his apparatus for testing tensile strengths (*Proceedings* of this Society, No. 6, 1863-64, p. 186) he was enabled to obtain data which by any previously-known method could only have been obtained, if at all, by an incredible amount of labour.

Effect of Bleaching upon Strength of Cotton.—These experiments were made upon printing cloth of eighteen threads to the quarter inch, American cotton, and bleached for printing by the low pressure process. The process included, among other treatments,—(1) Passing three times over a red-hot copper plate; (2) boiling sixteen hours with milk of lime; (3) boiling sixteen hours with soda and resin; (4) steeping in solution of bleaching-powder for several hours; (5) steeping in dilute hydrochloric acid for several hours.

	Warp.	Weft.
Strength of threads in the grey cloth S.V. (mean of thirty experiments)	3140 grs.	1714 grs.
Ditto in the bleached cloth S.V. (mean of thirty experiments)	2920 grs.	2785 grs.

The warp threads from two other pieces of cloth give as follow, being the means of forty experiments:—

	A.	B.
In the grey state	3407 grs.	3512 grs.
In the bleached state . . .	3708 grs.	4025 grs.

The cloth S.V. became elongated in the bleaching process, and contracted in width. The contraction in width, owing to the fulling up of the weft, will explain the increase of its strength, while the elongation may explain the diminution of strength in the warp. The cloth A., and also B., were chemically treated exactly as S.V., but were washed and dried loose, and not being fulled so much by the mechanical processes did not sensibly alter in length. The increased strength may be explained by the complete bedding of the cotton hairs, so forming a more compact thread. At any rate, it seems proved that the strength of cotton is not injured by the ordinary process of bleaching for printing.

Effect of Printing, Dyeing, Soaping, &c.—A portion of S.V. was printed dyed, and finished as a first-class madder purple, and twenty experiments made upon the warp and weft threads, with the following results:—

Strength of printed and finished warp .	3569
Ditto of printed and finished weft . .	2669

Here it is seen the warp threads have gained more than they lost in bleaching, while the weft threads have lost something. The increase of strength in the warp threads is partly, if not wholly, explained by the diminution of length, the two yards gained in bleaching, and rather more, being absorbed in the processes of dyeing, soaping, &c., and the thread consequently becomes thicker and stronger.

Mordanted Cloth Treated with Acid.—These experiments are interesting, as touching upon the chemical *versus* the physical theory of dyeing. A piece of calico was chosen printed by blocks in wide longitudinal stripes, with the usual mordants for madder or garancine dyeing; it was aged, cleared, &c., as usual, to remove all loose mordant. Portions containing mordanted and unmordanted parts were treated by hydrochloric acid to remove the mordants, then carefully washed, and the strength of the threads tested. The results are as follow:—

Iron mordant for black, warp threads, ten experiments	3450 grs.
Warp threads contiguous to the mordanted threads, ten experiments	3715 ,,
Same mordant, weft threads, six experiments .	2201 ,,
Same weft threads in the unmordanted parts, six experiments	2906 ,,

The above experiments show a decided diminution of strength in those threads which had received the mordant. The unmordanted threads had, of course, been submitted to the same acid and other treatments. A repetition of these experiments upon another piece of cloth of different origin, but similarly printed, and which had been dyed in madder and then treated with hydrochloric acid, gave the following results:—

Alumina mordant for red, warp threads, ten experiments	1906 grs.
Unmordanted threads, contiguous, ten experiments	2031 ,,
showing a diminution of strength.	
Iron mordant for black, warp threads, ten experiments	1631 ,,
Unmordanted threads, contiguous, ten experiments	2260 ,,
showing a considerable diminution of strength.	

Experiments on Cotton Hairs, taken from Mordanted and Unmordanted Threads, which had been Treated by Acid.

Alumina mordant for red, eight experiments .	60·3 grs.
Not mordanted adjacent hairs, five experiments.	71·6 ,,

The uncertainty as to whether the mordant had actually touched the hairs in the centre of the threads caused these experiments to be discontinued, and the following instituted:—

Cotton Mordanted in the Wool.—Small parcels of New Orleans cotton were steeped separately in ordinary iron liquor (crude pyrolignate of iron) and red liquor (crude acetate of alumina), saturated with these liquors, the excess expressed out, and then dried gently, and aged for twenty-four hours; afterwards well washed in lukewarm water and dried. A portion of each parcel was then treated with dilute hydrochloric acid, some of the original stock of New Orleans cotton being placed in the same acid, and going through the same treatments. The mordants being dissolved out, the cotton was well washed to free it from the acid, dried, and its strength ascertained with the following results:—

New Orleans cotton not mordanted, ten experiments	143·9 grs.
Ditto mordanted with iron, ten experiments .	96·8 ,,
Ditto mordanted with alumina, ten experiments	94·1 ,,

A very notable diminution of strength has occurred in the mordanted parcels.

Gun Cotton.—The only undeniable chemical compound which cotton forms with other elements without undergoing conspicuous physical change is in gun cotton. A sample of New Orleans was treated with equal volumes of concentrated sulphuric and nitric acids. It increased in weight 66 per cent., burned well, and was soluble in alcoholised ether. Twenty hairs being measured gave a mean length of 0·997 inch; twenty hairs before treating gave a mean length of 0·996 inch. The difference (0·001) being within the range of error, it may be said not to have changed in length. The strength of ten hairs was taken, and gave a mean of 85·4 grains. The mean strength of nineteen hairs before treatment being 138·1, there has been a considerable diminution of strength. This may not be true of all kinds of gun cotton.

Mercerised Cotton.—It is very well known that cotton cloth treated with concentrated solution of caustic soda shrinks in length and becomes stronger. The following experiments corroborate this:—New Orleans cotton was treated with soda solution sp. gr. 1·250. Twenty hairs being measured gave a mean length of 0·857 inch, being a contraction of 0·139 inch on the mean of twenty hairs measured before treatment. The mean strength of ten hairs is 154·1 grains against a mean strength of 138·1 grains before treatment. The reliability of these results is discussed by the author. The experiments in detail show wide discrepancies, and the maximum and minimum of a series are often at a considerable distance from the mean. This is a difficulty inherent to the subject, and can only be overcome or lessened by multiplying the experiments. Ten experiments seem to give a reliable mean, for in making twenty or thirty the first, second, and third tens give nearly the same mean. Most of the results are means of twenty experiments; and several of them having been repeated at long intervals and by different hands, without any important difference in the means, the author is of opinion that they express the truth, at the same time that they may be open to some numerical rectification.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(FIFTEENTH NOTICE.)

(*Continued from page 119.*)

"The genesis and constitution of aniline red," says Dr. Hofmann, "still remain to be investigated, though the chemical nature and composition of the substances are no longer doubtful." To the elucidation of these matters, the author of this report has largely contributed, while, as we have said, his claim to the discovery of aniline red is indisputable. The method by which he obtained it may yet be utilised, since we find in this report, in an extract from the proceedings of the *Société Industrielle de Mulhouse*, the following statement made by a mixed committee of chemists and manufacturers appointed to examine the question :—" We can," say the Committee, " by repeating Dr. Hofmann's process, prepare aniline red without danger, and with certainty of success, and we see no obstacle to the application of the process on a large scale; being convinced that in following the same process, but employing Payen's refrigerator, the operation may be carried on in an open vessel, and consequently without pressure."

Dr. Hofmann, our readers will remember, first obtained aniline red by heating together aniline and tetra-chloride of carbon in sealed tubes. The great obstacle to the extended use of this method, we imagine, would have been the cost of the chloride of carbon; but this obstacle, we believe, is now removed, since we have recently had our attention called to a specimen of the chloride which, we are informed, was made by a process that will enable it to be produced almost as cheap as sulphide of carbon. This process, we have no doubt, will attract the attention of manufacturers, and, perhaps, seeing the numerous possible applications of chloride of carbon, lead to great results.

Aniline red, as Dr. Hofmann obtained it, was largely contaminated with secondary products, and baffled his efforts to separate it. Mr. Nicholson, however, by his process, obtained a crystallised compound; and with this Dr. Hofmann resumed his researches, and soon " demonstrated that the aniline reds are salts of a peculiar and extremely remarkable compound, which plays the part of a well-defined base, and which the reporter proposes to designate by the name of *Rosaniline.*

" Rosaniline, in the anhydrous state, is represented by the formula $C_{20}H_{19}N_3$, and in the hydrated state, such as it assumes when isolated from its compounds, by the formula $C_{20}H_{21}N_3O = C_{20}H_{19}N_3,H_2O$.

" It is a triamine capable of combining with one, two, or three equivalents of acid. The pure aniline reds are saline compounds of rosaniline with one equivalent of acid.

" It is very interesting that rosaniline itself, when freshly prepared, is a colourless compound. It is nearly insoluble in water; slightly soluble in ammonia; more soluble in alcohol, with a deep red colour; and insoluble in ether. When exposed to the action of the air, rosaniline becomes rapidly rose-coloured, and finally of a deep red, probably in consequence of the formation of a carbonate. It is rather a powerful base, forming salts, almost all of which are remarkable for their beauty, and the facility with which they crystallise."

The monacid salts exhibit by reflection the lustrous metallic green colour seen in Mr. Nicholson's crowns. By transmitted light they are seen to be red, and their solutions possess the well-known magnificent crimson colour. According to Chevreul, the green colour reflected from the crystals is exactly complimentary to the red which the salts impart to wool and silk.

The triacid salts of the stronger acids are yellowish brown, both solid and in solution. They are much more soluble in water and alcohol than the monacid salts. Both classes of salts crystallise readily.

Dr. Hofmann proceeds to describe several of the salts—the hydrochlorate, sulphate, acetate, nitrate, chromate, and trinitrophenate; but to these we need not allude further than to remark that the acetate yields the finest crystals, Mr. Nicholson having obtained them an inch in diameter.

The tannates of rosaniline, described by M. Kopp, deserve a longer notice. " They are true carmine lakes, which rival the renowned carmine lake obtained from cochineal. They are entirely insoluble in water, but soluble in alcohol, wood spirit, and acetic acid. In the dry state they do not present the green metallic appearance, but preserve their beautiful carmine red. The tannate of rosaniline is of considerable importance to industry, not only because it is found on nearly all the cotton fabrics dyed and printed in red or rose with rosaniline, but also because, by reason of its insolubility, it enables the manufacturer to make use of the very dilute aqueous solutions which are often obtained during the purification of rosaniline." In fact, the best way of treating poor solutions is to precipitate them with fresh infusion of nut galls, which in a short time precipitates a magnificent red lake, and leaves a colourless mother liquor.

It would be unfair to quit the subject of aniline red without alluding to the labours of many Continental chemists who have been engaged in the examination. Our readers will remember the several contributions of Guignet, Béchamp, Willm, Persoz, De Luynes, and Salvétat, and, lastly, of M. Kopp, which have appeared in our pages. To the last-named chemist and the author of this Report we owe all the exact knowledge we have of the body.

A colourless body, leucaniline, which bears exactly the same relation to rosaniline as white does to blue indigo, is obtained when a solution of rosaniline in hydrochloric acid is left in contact with metallic zinc. Leucaniline differs from rosaniline by containing two equivalents more of hydrogen.

Rosaniline . . .	$C_{20}H_{19}N_3$
Leucaniline . . .	$C_{20}H_{21}N_3$
Blue indigo . . .	$C_{16}H_{10}N_2O_2$
White indigo . . .	$C_{16}H_{12}N_2O_2$

Oxidising agents, of course, convert leucaniline into rosaniline.

The Reporter passes on to the formation of aniline red, and here alludes to the remarkable experiments by which he discovered that neither pure aniline nor pure toluidine would produce the colour, but that when a mixture of the two bodies was treated with the chlorides of mercury or tin, or arsenic acid, the red colour was instantaneously produced, thereby proving that the two bases must co-operate in producing the result. This, he believes, gives a clue to the genesis not only of aniline red, but the tinctorial ammonias generally, and the Reporter intends to follow it. For the present we are left in the dark, but no doubt light will be thrown on the subject soon.

All the red derivations of aniline, it is remarked, may be regarded as salts of rosaniline. The fuchsine of M. Rénard consists chiefly of the hydrochlorate; azaleine of the nitrate; the crude red from arsenic acid as the arseniate, which, in the course of purification, is converted into hydrochlorate or acetate. A nearly colourless paste, imported from Mulhouse, which when dissolved in acetic acid gives a magnificent solution, is no doubt rosaniline, more or less pure, precipitated from a salt by a powerful basis such as soda or lime.

The phenomena observed in the application of aniline red may be briefly dismissed. When a stuff dyed with the red is acted on by a strong acid, the colour is discharged in consequence of the formation of a triacid salt, which is nearly colourless. By washing, the excess of acid is removed, and a monacid salt with the colour is reproduced. When the same stuff is treated with caustic soda the colour disappears in consequence of the liberation of colourless rosaniline, but, on washing the soda out, the colour reappears, the rosaniline probably becoming carbonated. When ammonia is used, the colour reappears slowly as the alkali evaporates, and quickly if heat be applied. If the fabric dyed with rosaniline be left a long time in weak ammonia, the colour scarcely returns on rinsing with water, obviously owing to the increased solubility of rosaniline in water containing ammonia, which separates the colour even from the mordant. The ease with which silk and wool are dyed by rosaniline salts is well known, and the animalisation of cotton is now well understood. Mr. Perkins' introduction of tannin as a mordant for cottons, and Mr. Crum's method of using glutin, have now removed all difficulties in the way of applying these dyes to vegetable fibres.

The yellow, green, blue, and black derivatives of aniline come next under notice.

The Prescriber's Analysis of the British Pharmacopœia. By J. Birbeck Nevins, M.D. Lond., &c., &c. London: Churchill and Son. 1864.

This is the first instalment of a long series of books which will appear on the British Pharmacopœia, and for the medical practitioner in either England, Ireland, or Scotland, we are doubtful whether any one more useful can be published. It is, however, only what it pretends to be—a prescriber's book—and is not at all intended for those who have to prepare medicines.

A few extracts will best show the scope of the book:—

"*Acidum Hydrocyanicum Dilutum* contains 2 per cent. of real acid. It is, therefore, the same strength as that of the Ph. L., and a London prescriber will not alter his dose; but it is only two-thirds the strength of the Edinburgh acid, and an Edinburgh prescriber must order at least half as much again as he has been accustomed to do. The strength of the Dublin acid varied; and no rule can be laid down."

"*Liquor Ammoniæ Acetatis.*—About five times as strong as Ph. L., and six times as strong as D. and E. It is difficult to assign any reason for this important change of strength without any indicating change of name. *Dose.*—F ℥ss. to f ʒv. in an eight-ounce mixture."

Another important change of strength is—

"*Tinctura Aconiti.*—Now only one-third the strength of Ph. L., one-fourth that of Ph. D., and less than one-fifth that of Fleming's tincture. The dose prescribed by physicians varies considerably, but it is recommended that the dose of this mixture should not exceed ♏v. to ♏x. If beyond this dose, it should be very carefully watched, and an interval of at least six hours should be allowed to elapse before it is repeated."

We can recommend this little book to prescribers, who may save themselves the expense of a Pharmacopœia by purchasing it.

NOTICES OF PATENTS.

2887. *Purifying Water.* F. Lipscombe, Strand, London. Dated October 27, 1862.

This invention consists in the preparation and use of a kind of charcoal impregnated with alkali for the purpose of purifying water by filtration. The wood is steeped in a solution of caustic soda or potash for several days, then dried and burnt into charcoal by heating in well-closed crucibles. The charcoal so obtained is afterwards reduced to a coarse powder, and used alone or between porous slabs of earthenware in the construction of filters.

The purification of water here described must be understood as referring merely to the separation of particles held mechanically suspended. By the action of the soda upon the lime salts dissolved in the water a small proportion of flocculent carbonate of lime would be precipitated which might serve as a medium for removing the visible impurities. It must be remembered, however, that the saline constituents of the water would be somewhat augmented by the soda salts passing from the charcoal into aqueous solution.

Grants of Provisional Protection for Six Months.

2589. William Cooke, Spring Gardens, London, "Improvements in the manufacture of saponaceous compounds."—Petitions recorded October 21, 1863.

167. Robert Irvine, Musselburgh, Thomas Richardson, Newcastle upon-Tyne, and John James Lundy, Leith, Midlothian, N.B., "Improvements in the extraction or manufacture of oils from animal substances."—Petition recorded January 21, 1864.

170. George Lander, Glasgow, Lanarkshire, N.B., "An improved treatment of tar or 'dead' oils to obtain products therefrom, and improvements in the apparatus employed in the process."—Petition recorded January 22, 1864.

226. Johann Zacherl, Bury Court, London, "An improved tincture or liquid preparation for destroying insects."—Petition recorded January 27, 1864.

238. William Edward Newton, Chancery Lane, London, "Improvements in the manufacture of certain kinds of soap."—A communication from Jules Mathieu, Rue St. Sébastien, Paris.—Petitions recorded January 28, 1864.

250. Thomas Martin Heathorn, Wateringbury, Kent, "Improvements in machinery for separating liquids from solid substances containing liquids."—Petitions recorded January 29, 1864.

266. William Edward Newton, Chancery Lane, London, "Improvements in the manufacture of aluminium."—A communication from Nicolas Bassett, Rue St. Sébastien, Paris."—Petitions recorded January 30, 1864.

268. Alexander Prince, Trafalgar Square, Charing Cross, London, "Improvements in the manufacture of artificial pavement, which improvements are also applicable to pottery ware."—A communication from Victor Duprat, Bordeaux, France.

270. Charles John Rowsell, Stockwell Villas, South Lambeth Road, Surrey, "Improvements in apparatus for viewing photographic and other pictures, coins, and medals, which is also applicable in the production of drawings and paintings."—Petitions recorded February 1, 1864.

276. William Henry Baldwin Castle, Portsmouth, Southampton, "A new or improved composition for coating and insulating metals, wood, cork, and other materials."

284. John Weir Draper Brown and Joseph Williams, Moorgate Street, London, "Improvements in gas burners, especially applicable to railway lamps and lanterns."

301. Eugen Lucius, Chatham Place, Blackfriars, London, "Improvements in the separation and purification of colours."

305. Joseph Lee and James Thomson, Liverpool, "Improvements in mounting photographic and other pictures."—Partly a communication from Malcolm Mouat, Niagara Falls, U.S.

307. Robert Owen, Manchester, "Improvements in apparatus for filtering water and other liquids."

329. François Alexandre Laurent and John Casthelaz, Rue St. Croix de la Bretonnerie, Paris, "Improvements in manufacturing violet colouring matters."

Notices to Proceed.

2550. Fedor de Wylde, Trinity Square, Tower Hill, London, "Improvements in the induration of stone, cement, stucco, brick, or other analogous materials, also in the manufacture of artificial stone."

2555. Arnold Budenberg, Manchester, "An improved blasting powder."—A communication from Bernhard August Schäffer and Christian Friedrich Budenburg, Buckau, Magdeburg, Prussia.—Petitions recorded October 19, 1863.

2607. Richard Archibald Brooman, Fleet Street, London, "A new material for tanning."—A communication from Antoine François Michel, Lyons, France.

2878. William Cowan, Edinburgh, Midlothian, N.B., "Improvements in gas meters."—Petition recorded November 17, 1863.

218. George Darlington, Minera, Denbighshire, "Improvements in the manufacture of zinc white."—Petition recorded January 26, 1864.

Royal Institution.—Tuesday, March 15, at three o'clock, Professor Marshall "On Animal Life." Thursday, March 17, at three o'clock, Professor Marshall "On Animal Life." Friday, March 18, at eight o'clock, Professor Tyndall, "Contributions to Molecular Physics." Saturday, March 19, at three o'clock, Professor Frankland "On the Metallic Elements."

CORRESPONDENCE.

Professor Frankland on the Glacial Epoch.

To the Editor of the Chemical News.

Sir,—In your report of my discourse on the Glacial Epoch there is an important error which I will thank you to correct in your next Number. In the table showing the height of the snow-line in Norway the numbers in the column headed "Coast" ought to have been in that headed "Interior," and *vice versa*. The following is the corrected table:—

Latitude.	Height of snow-line in feet. Coast.	Interior.	Difference.
60°	4450	5500	1050
62°	4150	5200	1050
64°	3650	4200	550
66°	3250	3700	450
68°	3000	3450	450
70°	2900	3350	450

In its uncorrected state the table would prove that the snow-line on the coast is higher than in the interior of the country; whereas it is quoted as evidence of the depression of the snow-line by the warm moist atmosphere of the coast.

I am, &c.
E. Frankland.

Royal Institution, March 7.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"Theory of Organic Peroxides," by Sir Benjamin Brodie.

Bankers' Cheques.—A discussion is going on in the *Bankers' Magazine* relative to the utility of Mr. Barclay's patent process for the prevention of forgery by the falsification of cheques. Our readers will find Mr. Barclay's process in Vol. I., p. 224, Chemical News. It appears that the writing on paper prepared by this process can be discharged by careful chemical treatment, which, of course, completely destroys the value of the patent. The subject is one which invites attention, and we shall return to the dispute.

Chemistry at the Custom House.—A short time ago a London chemist imported *syrupy* phosphoric acid from the Continent, upon which the Custom House authorities levied the duty for syrup! The duty was paid by the importer, who preferred to do so rather than appeal to the Commissioners.

New Zealand Exhibition.—An exhibition will be opened at Dunedin, Otago, in January, 1865. The articles exhibited will be classed as in the International Exhibition. No detonating or dangerous substances will be admitted; and spirits, oils, acids, corrosive salts, and things of a highly inflammable nature only by special permission, and in well-secured glass vessels. Application for space and further information must be made to the New Zealand Government agency, 3, Adelaide Place, King William Street, London.

Young v. Fernie.—This important trial has made considerable progress in the past week, and the plaintiff's case is now closed. The defence, we are informed, will last a much longer time. For the plaintiff, Drs. Hofmann, Playfair, and Odling, Sir R. Kane, and Mr. Young were examined to prove that, before the date of Mr. Young's patent, paraffin and paraffin oils had not been obtained by the distillation of bituminous coal as commercial products; that the heat described in the specification as "a low red heat," ranging from 800° to 1000° F. is the temperature at which these products are best produced; that Young's process differs essentially from those of Buisson (1845) and Hompesch (1841), the first of whom distilled coal at a red heat, whereby naphthaline and an excess of gaseous products would be formed; and the second, schist or clay slates. The great principle of Mr. Young's invention was said, by Dr. Hofmann, to be the temperature and the choice of coal. The case for the defendant contains some curious historical features, a passage from Glauber's "Opera Chemica" being quoted as revealing the germ of Mr. Young's invention; and the method of obtaining "oil of bricks" in the "Pharmacopœia Londinensis" for 1678 is quoted as an illustration of the process. The work of Morand, who distilled coal (?) in 1781, is also brought forward to prove want of novelty in the invention. These matters were not brought forward in the Scotch trial, of which, in other respects, the present is a mere repetition.

Parrot Coal.—Parrot coal is so called, I am told, because it chatters while burning.—*Mr. Young.*

Changes of Name.—The following is a list of the altered names of the chemicals in the British Pharmacopœia:—

Old Names.	New Names.
Ammoniæ sesquicarbonas.	Ammoniæ carbonas.
Antimonii oxysulphuretum.	Antimonium sulphuratum.
,, potassio-tartras.	,, tartaratum.
Bismuthi nitras.	Bismuthum album.
Calx chlorinata.	Calx chlorata.
Chloroformyl.	Chloroformum.
Ferri ammonio-citras.	Ferri et ammoniæ citras.
,, carbonas cum saccharo.	,, carbonas saccharata.
,, potassio-tartras.	Ferrum tartaratum.
,, sesquioxidum.	Ferri peroxidum.
Hydrargyri ammonio-chlorid	Hydrargyrum ammoniatum.
,, chloridum.	Calomelas. Hydrargyri subchloridum.
,, bichloridum.	Hydrargyrum corrosivum sublimatum. Hydrargyri chloridum.
,, iodidum.	,, iodidum viride.
,, nitrico-oxidum.	,, oxidum rubrum.
Iodinium.	Iodum.
Magnesia.	Magnesia levis.
Magnesiæ carbonas.	Magnesiæ carbonas levis.
Plumbi oxidum.	Lithargyrum.
Potassæ bitartras.	Potassæ tartras acida.
,, hydras.	Potassa caustica.
Potassii sulphuretum.	,, sulphurata.
Quinæ disulphas.	Quiniæ sulphas.
Sodæ chlorinatæ liquor.	Sodæ chloratæ liquor.
,, potassio-tartras.	,, et potassæ tartras.
Spiritus ætheris nitrici.	Spiritus ætheris nitrosi.
Sulphur.	Sulphur sublimatum.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

A. G. will find the information he wants in Richardson and Watts's "Chemical Technology."

W. Kendrick.—You cannot do without the salts of potash.

A Student.—1. The Giessen "Outlines of Analysis." 2. The latest edition of Rose's "Analytical Chemistry" is the French; we do not know the price. 3. They are not published in any paper.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Estimation of Sulphuric Acid in Salts of the Alkalies.

It is well known that precipitated sulphate of baryta may retain alkaline salts in quantities of 1·5 to 2 per cent. which cannot be removed by the most careful washing. Stolba (*Dingler's Polyt. Jour.*, April, 1863) obtains the sulphate of baryta pure by digesting it (after washing until the wash-waters no longer react of baryta) with 40-50 c. c. of a cold saturated solution of neutral acetate of copper and some acetic acid, at nearly a boiling heat for 10-15 minutes. (The commercial crystallised acetate of copper is purified from sulphuric acid, and at the same time saturated with sulphate of baryta, by adding to its boiling solution a slight excess of chloride of barium and acetic acid, and filtering from the precipitate.) During the digestion, enough acetic acid must be present to prevent the formation of basic salt on boiling. Should basic salt form, which may be readily perceived at the bottom of the vessel, more acetic acid must be added, and the digestion must be renewed for 10-15 minutes. During the process, the vessel containing the precipitate should be constantly agitated. The alkaline salts retained by the sulphate of baryta undergo double decomposition with acetate of copper, and the resulting products all admit of entire separation from the precipitate by means of hot water. The precipitate is washed until no reaction for copper is manifested on mixing the washings with ferrocyanide of potassium. This method the author also found satisfactory for the estimation of sulphuric acid in presence of a large excess of nitrate of baryta and chloride of barium.—S. W. J., in *American Journal of Science and Arts.*

TECHNICAL CHEMISTRY.

New Researches on the Preservation of Building and Ornamenting Materials—Production of Pseudomorphs, by M. Fred. Kuhlmann.

I have already proved that by operating at low or at moderate temperatures, hydrosulphuric acid transforms native carbonate of lead into sulphide of lead, preserving the form of carbonate of lead crystals; and that under the same circumstances malachite gives sulphide of copper, retaining the fibrous and ribbon-like appearance of malachite; finally that a similar transformation is effected by making sulphuretted hydrogen react on formiate of lead.

I have extended these reactions to the transformation of other crystallised products into sulphides, especially carbonate of thallium, which yielded sulphide of thallium, presenting the prismatic crystallisation of the carbonate; but on repeating these experiments, I found that if, after obtaining these pseudo-morphic sulphides, I kept them in a current of hydrosulphuric acid, gradually raising the temperature, it presently happened that the pseudomorphic crystals were destroyed, and in their place groups of crystals were formed of the shape peculiar to sulphides.

M. Des Cloizeaux was kind enough to carefully examine the artificial crystals, and found them, as to their crystalline form, generally similar to natural sulphides; I have made use of some of the hints given by this learned crystallographer. The current of gas considerably favours these transformations, giving greater mobility to the molecules of sulphides and facilitating their volatilisation. In this way the sulphide of lead produced by the transformation of the carbonate gives by volatilisation magnificent, brilliant-faced cubic crystals. These crystals attach themselves to the interior of the porcelain tubes in which the reaction takes place.

The sulphide of copper produced by the transformation of the malachite gives hexagonal tables without apparent macles, like Breithaupt's cupreine, and appearing to cleave at the base of the crystals. Natural protoxide of copper submitted to a current of hydrosulphuric acid forms a sulphide of copper, with an indigo-blue, crystalline, cuprous crust, corresponding to the natural sulphide known as *kupfer-indig*. According to M. Cloizeaux, cupreine, or hexagonal sulphide of copper, is often naturally associated with malachite.

Other crystallisations of artificial sulphides have been obtained by submitting oxides of silver and cadmium, at high temperatures to a current of hydrosulphuric acid. Sulphide of silver has been obtained crystallised in rhomboidal dodecahedrons, grouped with remarkable precision. Sulphide of cadmium is brown and transparent; it crystallises in regular dodecagonal prisms, terminated by a base or by one or two hexagonal pyramids which have not been determined.

Sulphide of thallium, more volatile than the two preceding sulphides, and in that respect resembling sulphide of lead, gives crystalline flakes, which in a first experiment were agglutinated through employing too high a temperature.

I hoped to obtain under the same circumstances sulphide of zinc, but the action of the hydrosulphuric current on white oxide of zinc produced, not sulphide, but only a yellowish-white oxide, a part of which volatilised and crystallised in flat flakes covered with very small crystals, which seemed to be hexagonal prisms.

General Considerations.—On looking at the various modifications sustained by metallic oxides contained in silicious pastes and in marbles, through the influence of oxidising agents, through reduction or sulphidation, it will be understood that these modifications are sometimes powerful causes of the disintegration of these stones, independently of the changes resulting from their coloration. As water which has penetrated porous stones when it freezes breaks them by its expansion, so oxides becoming peroxidised or by undergoing conversion into sulphides, produce in time disintegration of the hardest stones.

When there is a loss of material by the deoxidation of certain oxides or the destruction of bituminous matters, the stones diminish in hardness and increase in porosity, but in these cases the cause of disintegration is not so great; but if in a given stone 100 of oxygen are increased to 150, or 100 of oxygen were replaced by 200 of sulphur, the case would be very different. In the last instance the causes of disintegration were the same as if in a plaster or in porous stones saltpetre were developed by an abundant fixation of oxygen. Thus by these chemical actions the hardness is often diminished, while the penetration of resin into marble has a contrary effect, as it then becomes much harder and receives a much better polish.

In most of my experiments where modifications of colour have been produced by superoxidation, I have assisted the action of the oxidising agents by a high temperature; but these phenomena no doubt take place at the ordinary temperature solely by the action of atmospheric oxygen. Only in the latter case they are accomplished much more slowly. In proof whereof it is sufficient to examine carefully the action of the air on the outer marble of old monuments—the Dome and Baptistery of Florence are striking examples.

Even coloured jaspers cannot resist the prolonged action of the air, especially if their porousness is increased by solution—through the agency of rain—of the veins of carbonate of lime which often traverse them. The liability of natural stones to alter perfectly accounts for the preference given in former times to enamel as material for mosaics for exterior decoration. Decidedly, if the mosaics of St. Mark's at Venice, St. Peter's at Rome, and the portico of the cathedral of Orveito had been made of stone, they would not have preserved the freshness of colour which we now admire. This remark applies equally to the Pompeian mosaics which form one of the greatest treasures of the Neapolitan museum.

Many of my experiments support the opinion that many of our precious stones are coloured with organic matter, an opinion already stated by M. Levy with regard to the emerald, and by M. Gauthier de Claubry, with regard to red cornelian.

This loss of colour is not confined to these stones, but affects, among others, amethyst, in which oxide of manganese is generally considered as the principal colouring matter. However, Heintz in an analysis of the amethyst found not more than $\frac{1}{10000}$th of manganese; and besides the decoloration of the amethyst in presence of deoxidising gases renders it difficult to disprove the presence of an organic matter. The red quartz of Rabenstein contains about 1 per cent. of oxide of titanium. It would be premature to attribute the red colour of this quartz to organic matters, if it be true that it has the property of recovering its red colour some time after its destruction by heat.

The fact most important resulting from these researches, in a geological point of view, is that when mineral matters have taken by transformation pseudo-morphic forms, their molecules retain a tendency to form crystals or groups of crystals similar to those originally belonging to them, forms which these bodies naturally assume; my results, moreover, show that these transformations may be effected without pressure and under the influence of the same causes which determined the transformation, the only difference being the greater elevation of temperature.

The examples I have cited may throw some light on the various phenomena produced under the influence of volcanic emanations, in circumstances where the production of sulphides is so frequent, and where crystallisations analogous to those of specular oligistic iron may certainly take place. In a work published in 1858* I showed that isolated crystals may be produced by the wet way without water of crystallisation. I now give some fresh examples, in which non-volatile, isolated crystals are produced under the influence of gaseous currents at the ordinary pressure by over-exciting the crystallogenic property of certain oxides or sulphides by a high temperature. These facts may help to clear up some obscure points in the study of the numerous modifications which mineral matters on the surface of the globe undergo.—*Comptes Rendus*, lvii., 761. 63.

PHARMACY, TOXICOLOGY, &c.

The British Pharmacopœia.

(*Continued from page 124.*)

Carbonate of Ammonia is now the name for the compound, $2NH_4O,3CO_2$, generally known as sesquicarbonate. The present name is, perhaps, the best which could be applied in the Pharmacopœia, although the salt has been shown by Rose to be a mixture of $NH_4OCO_2+NH_4O2CO_2$. No directions are given for the preparation of this salt, the ordinary article of commerce being, we suppose, considered sufficiently pure. The tests will show it to be free from sal ammoniac and sulphate of ammonia, and also fixed impurities (lime or chloride of calcium) carried up mechanically in the sublimation.

Chloride of ammonium the Pharmacopœia still calls *Ammoniæ hydrochloras*, although the formula NH_4Cl is adopted. The compilers of the Pharmacopœia commit themselves to the assertion that the salt volatilises *without decomposition*, which was unnecessary, since it would have been sufficient to say, as in the case of the carbonate, that it volatilises entirely when heated.

Most elaborate directions are given for the preparation of *Ammoniæ liquor fortior*. They are very excellent in their way, and some such arrangement of apparatus as is here directed will always be adopted. But it need hardly be said that no pharmaceutist will go to the expense of the apparatus required, and take all the trouble necessary to procure in this way a few ounces of this solution when he can purchase it for about 8d. per lb.

The specific gravity of the new solution is to be 0·891, and it is said that it will contain 32·5 per cent. of ammoniacal gas. The latter point, we presume, has been determined by experiment, since it does not agree with either Davy, Dalton, or Ure's determinations.

The *liquor ammoniæ fortior* of the London Pharmacopœia had the density 0·882, and was said to contain about 30 per cent. of ammonia. This agrees with Davy's table. If, however, the statement in the British Pharmacopœia be true, we require a fresh table of the amount of real ammonia in solutions of different densities. According to Dalton, a solution having the density 0·89 will only contain 24·7 per cent.

The next article in the Materia Medica is *Ammoniæ phosphas*, but we postpone for the present a notice of this salt until we are able to report on the practical results of some experiments with the Pharmacopœia process. We may say at once, however, that the salt intended by and described in the Pharmacopœia is the compound $3NH_4O,PO_5 + 5HO$. Whether this salt can really be obtained in the way directed, and how long it will keep its composition under ordinary circumstances, we are at present unable to say. We are in a similar difficulty respecting the value of the salt if it be obtained.

The antimony compounds call for little remark. The teroxide, *Antimonii oxydum*, is made by adding the terchloride to water, and treating the oxychloride thus precipitated with carbonate of soda. The solution of terchloride, *antimonii terchloridi liquor*, is obtained by treating the tersulphuret with hydrochloric acid. The process for oxysulphuret, *antimonium sulphuratum* as it is now called, remains practically unchanged. The new method of making tartar emetic is to be commended for its simplicity as well as its efficacy. Oxide of antimony and bitartrate of potash are made into a paste, and left in this state—the most favourable for the combination of

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* *Comptes Rendus des Séances de l'Academie des Sciences.* Meeting of May 17, 1858.

the two—for twenty-four hours. After this more water is added, and the whole boiled for a quarter of an hour. The solution is then filtered and set aside to crystallise.

(To be continued.)

Crystallised Iodide of Iron and Quinine, by M. T. Smedt.

M. Smedt believes he has obtained this salt perfectly defined. The following is his process:—Take sulphide of barium, Q. S., make of it a concentrated solution, which precipitate by tincture of iodine; filter to separate the sulphur, and add sulphate of quinine, say thirty parts, dissolved in very concentrated and suitably acidulated alcohol.

Sulphate of baryta is precipitated, and iodide of quinine remains dissolved in the alcohol, communicating to it a dark yellow colour; filter, and wash the sulphate of baryta with alcohol, and then blend the two liquids; this iodide, separated from its solvent, is of a beautiful yellow orange colour; finally, take twelve parts of iodine and make into a very concentrated solution of iodide of iron, add to it the alcoholic solution of iodide of quinine and heat in a water bath; as the alcohol evaporates, the liquid takes a beautiful green colour, and a small quantity of a resinous substance of a darker colour separates from the liquid. Towards the end of the evaporation again add a little more alcohol, then filter and leave to crystallise; press out strongly the crystals and dry them.

Iodide of iron and quinine obtained in this way is in long yellow needles, quite soluble in boiling water, and not precipitated from it by cooling. This salt dissolves in cold alcohol and ether; it is odourless, and has a bitter ferruginous taste. In short, it seems to present all the characteristics of a perfectly-defined compound. Its composition, however, has not been verified by analysis.—*Journal de Pharmacie et de Chimie*, xliii., 485. 63.

PHYSICAL SCIENCE.

The Spectrum of Carbon.

Dr. Attfield some time ago published[*] an account of the spectrum of the common gas flame, of cyanogen, carbonic oxide, and sulphide of carbon, and finding the same common to all, inferred that it belonged to the one common constituent of these bodies—carbon.

M. Morren, of Marseilles,[†] has experimented with the same bodies as Dr. Attfield, and extended his observations to acetylene, the spectrum of which he finds to be identical with the others. He has, therefore, come to the same conclusion, viz., that the spectrum is that of the vapour of carbon.[‡]

In addition to the lines mentioned by Dr. Attfield, M. Morren describes several in the red band, and mentions that the violet shows as many as eighteen lines. Besides these, he adds that many hundreds of fine black lines, exactly like the lines of interference, are visible; these can only be seen when two or more prisms are employed.

We extract the *resumé* of M. Morren's work:—

"When any hydrocarbon is burnt with oxygen, a brilliant luminous point is obtained, the spectrum of which is the same for all.

"The same gases decomposed by the electric spark give the same spectrum, as also does the vapour of sulphide of carbon, acetylene, and carbonic oxide. The spectrum, therefore, can only be due to an element common to all the compounds; that is to say, carbon in a state of vapour.

"It follows that the theory of the candle flame must be somewhat modified. The base of the flame being blue is the vapour of carbon, preserved from combustion, but kept at a very high temperature by the envelope of hydrogen, the more combustible element of the gaseous carbides from the decomposition of wax; the hydrogen alone uniting with the oxygen of the air. Above the blue part comes the luminous part, produced by the passage of the carbon from the gaseous to the solid state, giving out in the passage a considerable amount of heat. The black cone surrounding the wick of the candle is formed of gaseous carburets of hydrogen, which only burn in the upper part of the flame when they come in contact with oxygen. Hydrogen, besides, being not only very combustible, but very subtle, diffusive, and penetrating, its combustion takes place under conditions in which it would be impossible for other gaseous bodies or vapours to burn. If a candle be gently moved so that the flame may be inclined and the air allowed to come in contact with the vapours of hydrocarbons which surround the wick, we see the hydrogen take fire, and above the flame appears the blue vapour of carbon. The latter can only exist alone, and give its luminous reactions when it has near it the high temperature produced by the combustion of hydrogen. When cyanogen is burnt in a current of oxygen, the high temperature produced in the interior of the flame makes the vapour of carbon intensely hot, and hence very luminous, consequently its spectrum very luminous."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 3, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

(Continued from page 126.)

In proceeding with our report of the Society's meeting of this date, we resume the subject by giving the discussion which followed the reading of Professor Abel's paper "*On the Non-metallic Impurities of Refined Copper.*"

Dr. A. W. Hofmann raised a question as to the existence of oxygen in copper in the form of suboxide, Cu_2O; he inclined to the belief that the combination described by Rose as the quadroxide of copper (Cu_4O) should, rather, be found dissolved in the metal. There were difficulties in the way of determining this point with precision; he would, however, ask the lecturer whether he had been enabled to isolate the oxide in question, and observe its physical characters?

Mr. Abel had frequently seen a red oxide remaining on the surface of the metal in its treatment with the silver solution in some of his analytical experiments, but he had never succeeded in collecting a quantity sufficient for an accurate determination of its composition. The amount of oxygen in copper had usually been stated as suboxide, Cu_2O, but with the view of leaving this question open, he had calculated his results both for the proportion of this oxide and for oxygen.

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[*] *Journal of Chemical Society*, series 2, vi., p. 97.

[†] "Des Phénoménes Lumineux que présentent quelques flammes et en particulier celle du Cyanogéne et de l'Acetylène," &c.

[‡] We confess we do not understand what experimentalists mean by the "vapour of carbon," as existing in a flame. It is notorious that no artificial heat yet produced will volatilise carbon, and yet we are asked to believe that the comparatively low temperature of the blue part of a candle-flame is hot enough to keep free carbon in a state of vapour. Moreover, how the carbon gets into the vaporous state requires explanation.—[W. C.]

Mr. **Frederick Field** had succeeded in detecting phosphorus in blister and bar copper, but never in the refined metal. The ores raised in the districts of Coquimbo and Copiapo, Chili, sometimes contained apatite and other phosphatic minerals in association, but the existence of the element, phosphorus, was not discoverable in the reduced metal after the operation of refining. The speaker had found selenium in specimens of copper ore from Bolivia.

Mr. **Alfred Smee** spoke in favour of the electrolytic method as a means of concentrating the impurities from a large quantity of the metal. When the chemical examination of copper was about to be conducted on this plan it was advisable to use a feeble current of electricity and a large positive pole. The melting of electrotype copper was an unsatisfactory operation, for he could never obtain a sound casting with this kind of metal; the ingots were always honeycombed; and on seeking the aid of a practical founder an assurance was given him to the effect that the addition of a small quantity of a "secret material" would at once overcome the difficulty, and produce a perfectly sound casting. At that time he could not, however, listen to the suggestion, inasmuch as his object was then to obtain pure fused copper for certain electrical experiments.

Dr. **De la Rue** had failed likewise in producing sound castings from electrotype copper melted in the ordinary manner, but he believed that better success could be ensured by manipulating the metal in an atmosphere of coal gas.

Dr. **A. W. Hofmann** reminded the Society that the electrolytic method of examination, which had just now been advocated by Mr. Smee, was one which, many years ago, in the hands of the Duc de Leuchtenberg, had furnished a rich harvest of results; but, judging from the long list of impurities then detected, it seemed more convenient to take account, not of those elements which were present, but, rather, of those which were absent.*

Dr. **Matthiessen** had no difficulty in producing sound castings of absolutely pure copper in an atmosphere free from oxygen, and the ingots so obtained were perfectly malleable and ductile. The metallic impurities which were most injurious to the working qualities of copper were three in number, viz., antimony, bismuth, and lead, and these he had usually been able to detect in overpoled copper. In reply to an inquiry on the part of Dr. Hofmann as to the occurrence of arsenic, the speaker stated that he had detected as much as 2½ per cent. of this element in Spanish copper.

Mr. **F. Field**, by way of testimony to the universality of bismuth as an impurity in copper, had recently sacrificed a gold coin of the present currency, in which he had no difficulty in detecting by the iodide of potassium test the presence of bismuth. This metal must have been introduced with the copper used in the alloy. He had examined likewise some Bactrian coins, which also were found to contain bismuth.

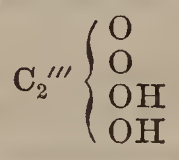
Dr. **Hugo Muller** had always detected bismuth amongst the metallic impurities which were left undissolved when commercial qualities of copper were connected with the oxygen pole of a voltaic arrangement.

Mr. **Abel** expressed a doubt as to the general validity of the commonly-received opinion which attributed to the suboxide of copper in the poled metal the power of counteracting the injurious influences of foreign metals. The coincidence of composition observed in the case of samples of tough pitch and overpoled copper examined by him required further elucidation, since with very slight chemical variations great differences were observed in their physical properties. In the examination of refined copper from Copiapo a trace of selenium had been detected.

The **President** then called upon Dr. Frankland to favour the Society with a statement in continuation of his researches "*On the Synthesis of Leucic Acid.*"

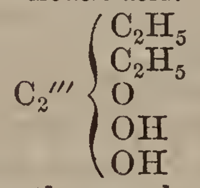
Dr. **Frankland** commenced by reminding the Society of the reaction which had first enabled him to produce leucic acid synthetically. By digesting oxalic ether with zinc ethyl, and afterwards distilling with water, he obtained leucic ether, which on treatment with an alkali furnished at once a salt of leucic acid. The relation between oxalic and leucic acids would become manifest by comparison of their formulæ, when it would be seen that the latter was formed from oxalic acid by the substitution of two atoms of the radical ethyl for one of oxygen. Leucic acid might, in fact, be viewed as dimethyl-oxalic acid.

Oxalic acid.



$$C_2''' \left\{ \begin{array}{l} O \\ O \\ OH \\ OH \end{array} \right.$$

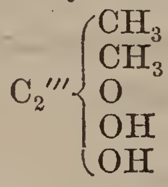
Leucic acid.



$$C_2''' \left\{ \begin{array}{l} C_2H_5 \\ C_2H_5 \\ O \\ OH \\ OH \end{array} \right.$$

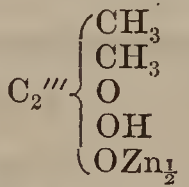
Since making these experiments the speaker, working in conjunction with Mr. Duppa, had discovered that the preliminary operation of preparing zinc ethyl might be dispensed with, and that it was only necessary to apply heat to a mixture of amalgamated zinc, iodide of ethyl, and oxalic ether, in proper proportions, in order to prepare at once the leucic ether. By proceeding in this manner a much larger yield than formerly was the result, and the product could be obtained at the ordinary atmospheric pressure. The authors had since applied this principle of formation to the homologous compounds of methyl and amyl. By digesting together the oxalate and iodide of methyl with amalgamated zinc at the temperature of about 100° C., employing an inverted Liebig's condenser to prevent loss from evaporation, the zinc salt of a new acid was formed, from which the corresponding barium and silver salts were prepared, and ultimately the acid itself. For the last substance the authors proposed the name "dimethyl-oxalic acid;" its formula, and that of the original zinc salt, were as follows:—

Dimethyl-oxalic acid.



$$C_2''' \left\{ \begin{array}{l} CH_3 \\ CH_3 \\ O \\ OH \\ OH \end{array} \right.$$

Zinc salt.



$$C_2''' \left\{ \begin{array}{l} CH_3 \\ CH_3 \\ O \\ OH \\ OZn_{\frac{1}{2}} \end{array} \right.$$

The new acid crystallises in the form of white prisms, which were easily fusible, and might be sublimed without decomposition. By exposure to the air at the common temperature it evaporated slowly like camphor. The barium salt was soluble both in alcohol and water, but not so in ether, and crystallised in brilliant needles. The silver salt was obtained in the state of purity for the purpose of analysis; it crystallised in groups of pearly plates. The most remarkable difference observed between the homologous reactions just now described, consists in the circumstance that no compound corresponding to leucic ether could be obtained in the case of the new acid. All attempts to produce it have hitherto failed, and there was certainly no disposition towards any union being effected by digesting the pure acid with absolute alcohol. The authors were now engaged in the investigation of several other products belonging to the lactic series.

The **President**, after moving a vote of thanks to the authors for their interesting communication, inquired of Dr. Frankland whether it would be possible to leave out the iodide of ethyl in the production of leucic acid, seeing that the required radical was already contained in the oxalic ether?

Dr. **Frankland** replied that oxalic ether could not be employed alone; he found, however, that the new acid might be produced from a mixture of iodide of ethyl and oxalate of methyl.

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* For an account of the Duc de Leuchtenberg's experiments *vide* Hofmann and De la Rue's Annual Report, vol. ii., p. 276.—Ed. *C.N.*

Dr. **Hofmann** asked whether it could be shown that there was really a mutual decomposition brought about on mixing the oxalate of methyl with the iodide of ethyl? and, secondly, not having been present at the reading of the former paper, he was very anxious to learn whether leucic acid produced synthetically was identical, or only isomeric, with the substance described by M. Strecker as being formed by the action of nitrous acid upon leucine?

Dr. **Frankland** considered there was satisfactory proof of a mutual decomposition being induced when the oxalate of one radical was mixed with the iodide of another: thus, a notable depression of temperature, amounting to five degrees centigrade, could be remarked when iodide of ethyl was brought into contact with the oxalate of amyl. The products of distillation also confirmed this opinion. With regard to the properties of leucic acid from the two different sources mentioned, he considered their identity sufficiently established; the physical characters were similar, the melting points were absolutely identical, and the degree of solubility of the zinc salt, as formerly stated by Wagner, accorded with his own results.

Dr. **Hofmann** cited the isomerism of the acetate of methyl and the formiate of ethyl as an instance in which the boiling-points were identical, but the addition of an alkali showed at once the difference in their constitution.

Professor **Wanklyn** remembered reading an account of some experiments made by a French chemist, he believed by Berthelot, which went far towards proving that the radicals in mixed ethers were distributed like metals in salts. Adopting a suggestion offered to the effect that these experiments were made by Friedel and Kraffts, a humorous discussion upon nationalities brought the proceedings to a close, and the meeting was adjourned to the 17th inst., as already reported.

CAVENDISH SOCIETY.

Tuesday, March 1.

The Master *of the* Mint, *President, in the Chair.*

The seventeenth anniversary meeting of this Society was held at the rooms of the Chemical Society, Burlington House.

The **Secretary** read the following report of the Council:—At the last anniversary meeting, the Council announced the completion of the fifteenth volume of the translation of Gmelin's "Chemistry," which was supplied to members for 1861, and they expressed regret at the delay which attended the production of that volume, although it arose from causes over which they had no control. During the year that has since elapsed another volume of the same work has been in preparation, and it is now nearly ready for publication. This constitutes the sixteenth volume of Gmelin, which will be issued in about a month from the present time as a book for 1862. The editor thinks that one more volume, in addition to that now in hand, will complete the work, with the exception of the index, which is also in hand. A reference to previous reports and to resolutions passed at meetings at which the position of the Society and the progress made in the work it had undertaken have been fully discussed, will serve to explain the causes of the comparative inactivity which has marked the proceedings of the Society for several years past. It is unnecessary to repeat here what has already been said, beyond simply stating that the operations of the Society are now confined to the completion of the translation of Gmelin's "Chemistry," and that the progress made with that work is necessarily limited by the rate at which the German edition is produced. When the Council found that the German work was not produced sufficiently fast to enable the English editor to prepare a volume of the translation every year, they refrained from applying to the members for their subscriptions during the delay that occurred in supplying the books; and on this account the accompanying financial statement gives the receipts and expenditure for the last two years, during which time only one volume has been issued. The Council hope and believe that when the subscriptions are paid up for the present year (1864) there will be funds enough in hand to defray all the expenses of the Society attending the completion of their great and now only remaining unfinished work, and including the index to that work.

Statement of Receipts and Expenditure of the Cavendish Society, from March 1, 1862, to March 1, 1864.

Receipts.

	£	s.	d.
Balance in hand on March 1, 1862 . .	375	15	5
2 Subscriptions for 1855	2	2	0
2 ,, ,, 1856	2	2	0
9 ,, ,, 1857	9	9	0
25 ,, ,, 1858	26	5	0
38 ,, ,, 1859	39	18	0
39 ,, ,, 1860	40	19	0
47 ,, ,, 1861	49	7	0
147 ,, ,, 1862	154	7	0
32 ,, ,, 1863	33	12	0
1 ,, ,, 1864	1	1	0
Sale of Books	55	17	6
	790	14	11

Expenditure.

	£	s.	d.
Petty Cash	1	18	0
Agent, for distribution of books, &c., two years	80	0	0
Insurance, two years	4	8	0
Collectors, two years	12	9	9
Editorial expenses	210	17	6
Paper	67	0	7
Printing	159	14	6
Binding	34	5	3
	570	13	7
Balance in hand	220	1	4
	790	14	11

Examined and found correct,

March 1, 1864. Henry Deane.

The usual votes of thanks to the President, Council, and Secretaries were passed.

In acknowledging the vote of thanks to the President, Professor Graham said it would be proper to make a few remarks on the position of the Society. He considered its mission nearly fulfilled. When the publication of Gmelin's "Chemistry" was completed, the Society would have accomplished all that could be expected of it. Societies like the Cavendish in the present day could not compete with private enterprise, which now engaged in publications such as would not have been undertaken at the time the society was commenced. As an illustration, he might mention Galloway's "Second Step in Chemistry"—a work comparable to the volume of memoirs published by the Society, and which would not have been undertaken by a private publisher sixteen years ago. The Society had, in fact, been superseded by the press, and was no longer called for. It might, therefore, be allowed to expire when the great work of Gmelin is completed.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture VII.—*Thursday, January 14, 1864.*

Ladies and Gentlemen,—In the last lecture we entered upon the consideration of sulphur, and the compounds of sulphur which exist in nature. We shall have occasion again to advert to this important branch of chemical geology when we come to speak of volcanoes. Sulphur, I informed you, exists in several states in nature. First, we have it in the isolated state, it being a frequent product of volcanoes. It occurs in a state of combination as sulphuric acid, as in gypsum, which abounds in nature. It is evolved from volcanoes in the form of sulphurous acid, and it also occurs in the form of sulphuretted hydrogen, as in various mineral waters. We then went on to consider certain sulphides, and proceeded as far as bisulphide of iron, iron pyrites, which exists abundantly diffused in nature. I explained to you the methods of producing this substance artificially, so far as they are yet known. In nature it is in general clearly produced in the wet way. It cannot exist at a high temperature. I do not know what the effect of enormous pressure may be—the favourite hypothesis of geologists. When exposed to a red heat in a closed vessel about half the amount of sulphur which iron pyrites contains is liberated. We have positive and direct proof of its formation by the wet way. Of that there can be no doubt whatever. I showed you specimens of common clay ironstone from our coal measures—a material which clearly has never been exposed to the action of a high temperature, and we frequently find in clefts of such ironstone iron pyrites. Again, its association with various mineral substances in lodes—substances which we know have been produced by the wet way—proves clearly that iron pyrites also must have been produced under similar conditions.

We have now to speak of another compound of sulphur and iron—namely, magnetic pyrites, which consists of six equivalents of protosulphide of iron and one of the bisulphide, for such may be regarded as its constitution. There are various modes of stating the rational constitution of this body—six equivalents of protosulphide of iron, that is, a sulphide of iron in which the iron and sulphur are in the proportion of one atom of each, and one equivalent of the bisulphide—$6FeS,FeS_2$, or its formula may be expressed thus:—$5FeS,Fe_2S_3$.

It crystallises in the rhombohedral system, but is rarely met with crystallised. It is feebly attracted by the magnet, and is itself sometimes magnetic. Hence its name. It is brittle, and has a metallic lustre, and a characteristic bronze-like tint. Its specific gravity is 4·6 or 4·7. It is readily fusible, and it is produced artificially by directly heating together sulphur and iron; but this is clearly not the way in which it has been formed in nature—at all events, in many cases. There are many points concerning the precise conditions under which these sulphides and various other compounds have been produced in nature which yet require investigation, and are still very obscure. We may know certainly the fact that a sulphide has been produced by the agency of liquids, but we may not be able to state the precise conditions which have been employed by nature for that purpose. There is one point in connexion with this magnetic sulphide of iron which deserves attention—namely, that it frequently contains nickel. A large quantity of the magnetic sulphide found in Norway, for example, is nickeliferous, and has been worked on account of that metal. In fact, wherever the magnetic sulphide is found in large quantity, it may be desirable to search for the presence of nickel in it, nickel being a metal of considerable value.

Galena, or the sulphide of lead, is frequently found in nature, and contains one equivalent of each of its constituents—sulphur and lead. It is fixed—at all events, under ordinary conditions. It may be fused in a close vessel without sensible loss, yet at high temperatures it may be sublimed, and obtained in a distinctly crystallised form. In nature it occurs magnificently crystallised in cubes, as every one knows who is accustomed to mineralogical cabinets. I have seen it most beautifully crystallised by sublimation in furnace operations. If any one will watch a common lead furnace during the roasting of the ore, in the first stage of the operation he will see little crystals of galena sublimed. Again, in blast furnaces, and in the smelting of lead slags, it sometimes occurs at the top of the furnace, beautifully crystallised. But there is no doubt that in nature it has been generally formed in the wet way, and not by the direct method of fusing its constituents together. We have specimens of common clay iron ore containing galena. Its association with certain mineral substances clearly proves that it has in many cases—certainly in mineral lodes—been formed through the agency of water. I have here, for example, a specimen of galena crystallised upon brown spar—carbonate of iron. The carbonate of iron cannot exist at a high temperature, and we know that it has been deposited by water. If, therefore, we find galena in it, we may be quite sure that the conditions under which these two substances have been produced are essentially the same. It occurs also in association with coal at Bedworth, in Warwickshire. I have seen specimens of large size from that place. There is a curious point connected with galena which deserves attention. I think I may say that all galena, without any exception whatever, contains silver. It has been asserted in some works on mineralogy that certain kinds of galena, like that in Przibram, in Hungary, are free from silver. They are practically free from silver, and do not contain a sufficient amount to render its extraction profitable; but silver is present, I am sure. Never have I met with a single specimen of galena from which I have not been able to extract a sensible amount of silver; and not only so, but I am enabled also to state that gold is a constant ingredient. We have examined many specimens, and never failed to extract a sensible and visible trace of gold—very small, it is true, but sufficient for its identification. And, further, we have never succeeded in finding an ordinary compound of lead, whether litharge, or red lead, or even the lead smoke which escapes from the chimneys of the lead furnaces, from which we have not been able to extract a sensible amount of gold. Here is gold from some thirty or forty specimens which have been examined. All the records of the analyses have been preserved in these hermetically-sealed tubes. This diffusion of gold with lead is a very curious fact.

We now come to the consideration of sulphide of zinc, or blende. Zinc and sulphur may be united when heated, but they then form an infusible sulphide, which protects the subjacent metal from further action. The sulphide of zinc is practically infusible, at all events, in our furnaces. If you take it as thrown down from solution, in the form of a nearly white powder, and expose it to a very high temperature in a crucible, it sinters together, and appears to be somewhat volatile, and its vapour is deposited in a crystalline form. There is no doubt that in nature blende is generally thrown down from solution. I will not say always, because nature has resorted sometimes to several ways of doing the same thing. There are some men who are ardent Plutonists, who believe in nothing but the agency of fire, and there are others who believe in nothing but the agency of water. There is no doubt that nature, in producing the various substances around us, has availed herself of every kind of agency, sometimes using water, and sometimes using fire. It is certain that blende has been thrown down from solution. The same proof I can urge as I urged with respect to the formation of galena and the bisulphide of iron—namely, the conditions under which we find it. It occurs by no means unfrequently in our clay iron ores, sometimes in considerable abundance. I have seen it continually in Staffordshire, filling the cracks of clay iron ores, sometimes associated with copper pyrites, and sometimes with iron pyrites. Here are specimens illustrative of all these points. Here is one piece containing blende of a considerable size. We shall find that when these minerals contain blende it will exist in largest proportions towards the exterior. Senarmont obtained blende crystallised by heating salts of zinc with alkaline sulphides at about 170° centigrade.

Copper pyrites is a very important ore occurring in nature. It is a compound, or may be regarded as a compound, of one equivalent of disulphide of copper, and one equivalent of sesquisulphide of iron. Disulphide of copper is compounded of two equivalents of copper, and one of sulphur—Cu_2S. The formula of copper pyrites is—

$$Cu_2S + Fe_2S_3.$$

It may be prepared directly with certain precautions; and here, again, there is not the slightest doubt—considering the minerals with which we find it associated in nature, and the conditions in which it occurs—that it also, like other sulphides, has been produced generally, if not always, through the agency of liquids. Senarmont made it by heating, at about 250° centigrade, a mixture of protochloride of iron and chloride of copper, in nearly the right proportions to form the sulphide, with a solution of persulphide of potassium in insufficient quantity to decompose the chlorides, and with a great excess of bicarbonate of soda. By this means he got the substance in a crystallised state.

Instead of now taking up the subject which is next in order on the prospectus—namely, sea-water and certain saliferous deposits, I propose to finish the subject of the metals, and proceed at once to iron, that most important and most wonderful of all metals—wonderful in every respect, the most extensively diffused, and the most useful of all metals.

I will first refer to meteoric iron—those masses of iron which are supposed to be minute asteroids, in fact, describing definite planetary orbits. It is not my intention to discourse on the subject of meteorites or aerolites. These masses of iron are remarkable in many respects. The fact of their being alloyed with nickel is curious. We have recently been examining different specimens of iron from different manufactories, and on searching carefully have found in almost every specimen both nickel and cobalt, in very small quantity, but sufficient to prove the general connexion between these three metals. It is not at all improbable that when the search is more extended and conducted with requisite care, we shall find that these metals are pretty generally associated. Here is a magnificent specimen of meteoric iron, the surface of which presents a peculiar structure or pattern developed by the operation of acids. Here on this surface we have the pattern most beautifully shown. With regard to the action of acids on metals, I may state that almost all metals after fusion have a distinctly crystalline structure. It may not be visible to the eye; for instance, if you take a pig of lead nothing will appear to the eye less crystalline, but yet it may be shown that every pig of lead consists of a mass of crystals. Certain metals may present a vitreous structure—if I may use the term with regard to metals—a structure like glass, breaking with a conchoidal fracture.

Experiments might readily be made—and really it were desirable that they should be made on some scale—to ascertain whether we could not imitate these appearances exactly by artificial alloys of iron and nickel. We have now means at our command, with regard both to temperature and obtaining nickel at a moderate cost, which did not exist in former times. The structure which is developed by the operation of acids deserves attention. It is remarkable that a mass consisting of an aggregation of the same crystals should develope this peculiar structure by this etching action. Why should one part be attacked more than another? And yet such is the fact. It is curious, moreover, that certain crystals are acted upon with different degrees of intensity on their different faces.

With regard to these masses of meteoric iron, I think that on a former occasion I alluded to one very curious variety, known as Pallas's meteorite. A similar variety has been found in Atacama, on the slopes of the Andes. These meteorites contain chrysolite, but how it came there I cannot understand. It is singular that a separation should not have taken place between the iron and the chrysolite, as there is reason to believe that the mass must have been exposed to a very high temperature, and the two substances differ very much in specific gravity. This is one of the enigmas which must remain for future solution.

I need not say anything with regard to the supposed source of meteoric iron. Whether meteorites are a segregation of the cosmical dust of which we heard some time ago, I do not know. With reference to that conjecture, Berzelius put the very pertinent question,—If they be composed of this cosmical dust, is it not a strange thing that none should ever have been found on the snow-capped tops of our highest mountains? Reports have been afloat with reference to meteoric sounds in connection with shooting stars, and it is astounding how people who are unaccustomed to the observation of natural phenomena fancy that they see and hear things which have no existence in fact. Only a short time ago, it was stated, with respect to these meteoric sounds, that some mysterious noise, like the falling of crockery, was heard in a house, but no meteor was seen. However, tidings afterwards reached the household of a meteorite having passed about the time the sound was heard, and that was quite sufficient to induce them to attribute the sound to the meteorite. This is a specimen of the kind of evidence on which some of these alleged phenomena rest. Not long ago there was a great noise made in London in consequence of the discovery of an alleged meteorite in a tree. The substance, however, upon examination, turned out to be merely a mass of furnace slag. Very curious things have sometimes been found in trees. The bones of animals have been found embedded in trees, but it is not likely that they have descended from heaven. It is rather strange that we have not had more evidence of the existence of meteorites in former times. I find in *Poggendorff's Annalen* an interesting account of a meteorite discovered deep in sandstone at Oldenburg. It presents the characteristic figures by etching, and is rusted on the exterior exuding drops of sesquichloride of iron. Probably we shall get evidence, at some time or other, of the existence of meteorites in sedimentary beds. They must have fallen, and they ought to be there, or what remains of them ought to be there.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 23, 1864.

E. W. BINNEY, *F.R.S.*, *F.G.S.*, *President, in the Chair.*

WALTER CRUM, F.R.S., was elected an honorary member of the Society.

The formation of a Photographic Section was announced.

On the motion of Mr. Sidebotham, seconded by Mr. Parry, it was unanimously resolved that the Sections of the Society, with the consent of the Council, shall have power to elect sectional associates, subject to rules which have been drawn up by the Council. The arrangement to take place immediately, and to continue in force until the end of the ensuing Session.

Professor ROSCOE stated that the question of the possibility of taking photographic portraits by means of the magnesium light was now satisfactorily settled; he exhibited some prints of a portrait which Mr. Brothers and he had taken at five o'clock p.m. on Monday, the 22nd, by burning fifteen grains of magnesium in the form of fine wire, at a distance of about eight feet from the sitter. The negative thus produced was stated by Mr. Brothers to be fully equal to any obtained by sunlight in the most favourable state of the atmosphere, the distribution of light and shade was most agreeable, any harshness of the shadows being completely removed simply by slightly moving the wire whilst it is burning. During the meeting, Mr. Brothers took an excellent negative copy of Chantrey's fine bust of the late Dr. W. Henry in the possession of the Society, by burning ten grains of magnesium wire, the light lasting for fifty-nine seconds. It is expected that the quantity of wire necessary for taking a photographic portrait can be sold at the cost of a very few pence.

Mr. G. C. Lowe described a meteor seen by him on Sunday, February 7, at 6h. 11m. p.m. Greenwich mean time. It was first seen just below the constellation Cassiopeia, and was in full view throughout its entire passage, which occupied about four seconds. It descended towards the horizon at an angle of about 40°, passing between the two stars η Pegasi and Scheat, and disappeared without breaking up when at the altitude of α Pegasi. It was of an elongated pear shape, and was followed by a short train of sparks of a dull red colour, the meteor itself being a very pale blue, somewhat less than the diameter of the moon in apparent length, and about six or eight times brighter than the planet Jupiter.

This meteor was also seen by Mr. Wylde, Mr. Parry, and Mr. Pochin, who all described it as one of great brilliancy.

Mr. Sidebotham exhibited a copy by photo-lithography of one of the earliest editions of Shakespere, which he believed to be the first published work in which that process was employed.

Mr. Brockbank exhibited a bead-like fossil body which had been found in a sandstone near Stainmoor, and had been traced to full four feet in length.

The President said that a similar fossil had been described by Mr. George Tate, F.G.S., of Alnwick, in the *Transactions* of the Berwickshire Naturalists' Club for 1858, under the name *Eione Moniliformis*, which was found in the sandstones of the mountain limestone of Howick, Scremerston, and Haltwhistle, in Northumberland and in Yorkshire. Mr. Hindson, of Kirby Lonsdale, has also found the same fossil in sandstones of a similar age in that district, and probably they would be met with in the beds of the millstone grit further south, at Dyke Nook, near Keighley, and Saltersbrook, near Woodhead, where he (the president) had observed specimens of several species of M. Loy's genus of *Crassopodia* with which they have been found associated.

Dr. Roscoe read a paper by Mr. Edward Sondstadt, entitled, "*Note on the Preparation of Calcium.*" Although Davy demonstrated the existence of calcium, and obtained it in an impure condition, by his well-known method more than half a century ago, there are but two methods at present known whereby this most abundant of all the metals, excepting perhaps aluminium, can be obtained in a state of comparative purity. Matthiessen, following a method which was, I think, first indicated by Bunsen, who obtained magnesium by the electrolysis of the fused chloride of magnesium, obtained calcium by the electrolysis of a mixture of the fused chlorides of calcium and of strontium. This method, however, of obtaining the metals of lime and of magnesia is exceedingly troublesome, principally because of the floating up and burning of the metal on the surface of the salt electrolysed. The second of the two methods referred to is that adopted by Liès Bodart, and Gobin, who obtained calcium by heating iodide of calcium with sodium in an iron crucible, the cover of which was securely fastened down. The only objection to be made to this process is the troublesomeness and expense of preparing anhydrous iodide of calcium, which, like chloride of magnesium, is apt to undergo partial decomposition during ignition—and it must be remembered that partial decomposition of iodide of calcium involves the formation of lime, a substance practically infusible, which during the reaction with sodium, must prevent, if present, the aggregation of the minute particles of reduced calcium into globules. In order to overcome this, and the before-named objection to the process, the author fuses together equivalent quantities of iodide of potassium and of chloride of calcium. The fused mass is poured into an iron crucible and covered till cool enough to handle; the mass is then dropped out, and a rather less than an equivalent quantity of sodium is put into the crucible, and the mixture of calcium and potassium salts is placed above it. The crucible is then closely covered and heated to redness. The heat need neither be strong nor long continued. The best results are obtained when the crucible cover is fastened down, but calcium in lump may be obtained without using more pressure than that afforded by a well-fitting lid. The reaction does not appear to be violent, and hence the advantage of considerable pressure. Is the slight violence of the reaction between sodium and the calcium salt owing to the near approach of the two metals as to atomic weight, and thence specific heat? It is easier to obtain calcium in lump by the modification of Liès Bodart's process, that I have described, in a small way, than it is to obtain magnesium in lump on a like scale.

A paper was read by J. C. Dyer, V.P., "*On the Nature of Friction in Mechanics,*" in which he stated that:—Resistance to motion by surface contact arises from distinct kinds of obstruction, according to the nature of the moving bodies and to the condition of their surfaces. These present problems that have been investigated by many writers and experimenters; but no fixed law or rule has been discovered for measuring such resistances as applied to different kinds of friction. The inquiries have mostly related to the action of solid surfaces, and some approach to the measure of their resistance has been attained by finding the relation of falling weights to those sliding over horizontal surfaces of different kinds of woods, metals, glass, marbles, &c.; but little or nothing has been accomplished towards showing the nature of the surface resistance to solids moving through water or other liquids. The experiments of Captain Beaufort and Robert Fulton afford data for the sum of such resistance, but not for its mode of action. In the case of solids, if the surfaces in contact were perfectly level and hard, they would slide over each other without friction; but as none such are known, their resistance to motion arises from the projecting points and indentations, which grapple with more or less force, causing the moving body to rise and fall and to abrade and wear down the surfaces; thus gravity and cohesion constitute the counteracting or compound force called friction. In railway wheels, as small portions of the peripheries are in contact with the rails, when both are in good order but slight resistance is offered; but even in this case the common measure of the weight into the distance does not strictly apply, and the amount of tractive power is obtained from experience only. This retarding force too is divided between the friction on the rails and that of the air passed through. The action of rolling surfaces such as wheels and pinions of watches, clocks, and other machinery, is amply explained, and rules given for minimum friction, in the works of Berthoud, Camming, and Halton, on clocks and watches, by Camus on the teeth of wheels, and in D. Fairbairn's work on mill-gearing, wherein we see that if the rolling surfaces were all smooth, hard, and of curvatures adapted to such motion, they would offer no friction. The motions of shafts on fixed bearings, if the metal surfaces come in contact, will draw in and compress the air, and by heating the shaft prevent safe working; hence lubricating matter is used to limit the contact of the metals, so that only some of their prominent parts touch, to produce attrition, or friction. The motion of bodies through water involved several kinds of resistance of a more complex nature, the measure of which has not been given by any of the able writers on that subject, nor has any formula been applied thereto for solving the questions of the compound resistances to be overcome by ships and other bodies moving through water. Some authors have taken the measure of this resistance to be as the squares of the velocities; but this fails, because the different kinds of resistance are not alike called into action in the different cases adduced. Those of cannon balls ricocheting from water, the sinking of plummets in deep soundings, and floating bodies at different depths from the surface, present each of them reacting forces too complex to admit of any simple rule of measurement, the separate nature of which need not be here repeated; but it may be said that the aggregate of the resisting forces called friction must of necessity consist of the reaction of gravity, inertia, cohesion, elasticity, and adhesion of bodies, in their varied degrees of action, so that no simple measure of them as friction is likely to be discovered, and we thus see that friction is a compound term, pointing to the action of several retarding forces, and to comprehend the nature of these we must analyse these natural forces as they are respectiveiy called into action under the common but vague term of friction.

MICROSCOPICAL SECTION.

Ordinary Meeting, February 16, 1864.

Joseph Sidebotham, *Esq., President of the Section, in the Chair.*

Mr. Brothers presented some very beautiful photographs from microscopic objects to the Section.

Mr. Lynde mentioned that one of the members, Mr. Grindon, had promised to procure a supply of fresh cotton plants, in all stages of growth, beginning in June, and suggested that, as the time for their examination would be during the recess, a committee should be appointed to examine the subject of the cotton fibre very carefully, and report thereon at the first meeting in the next Winter Session.

Mr. Sidebotham suggested that in using very high powers, such as the $\frac{1}{25}$th, if slips of mica were used for mounting the objects, together with mica covers, there would be no risk of damage to these lenses, which could thus be used in many examinations where the fear of damage now prevents their employmont.

Mr. Dancer exhibited a new and improved Oxycalcium Microscope; the lenses were adapted to the ordinary form of lantern, and consisted of new combinations of lenses, giving a large flat field, and plenty of light, along with very fine definition. The room was darkened, and Mr. Dancer exhibited an extensive range of objects with several powers, on a large stretched paper screen, eight feet by five feet, showing the application of this instrument to the uses of lectures on various objects. Besides the usual objects, such as sections of wood, objects mounted in fluid, living animalculæ, the process of crystallisation, electrical action, &c., were exhibited. A new combination forming a one-inch object glass for the achromatic microscope was also exhibited by Mr. Dancer, and was much admired.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(sixteenth notice.)

(Continued from page 130.)

Aniline yellow, to which the name Chrysaniline has been given, is very easily prepared. The residue left after the extraction of rosaniline is submitted to a current of steam, which carries away the base in solution. Nitric acid is added to the condensed liquor, by which chrysaniline is precipitated in the form of a nitrate. This nitrate is so insoluble "that," says the Reporter, "nitric acid may be precipitated even from a dilute aqueous solution by means of the more soluble hydrochlorate or acetate of chrysaniline; these, when poured into a nitric solution, rapidly give rise to the formation of an orange-red crystalline precipitate of nitrate of chrysaniline." Here, perhaps, may be a means of estimating nitric acid and nitrates when present in only small amounts.

Chrysaniline only differs from rosaniline by containing two fewer equivalents of hydrogen.

Chrysaniline . . .	$C_{20}H_{17}N_3$
Rosaniline	$C_{20}H_{19}N_3$
Leucaniline	$C_{20}H_{21}N_3$

Aniline green, or Emeraldine, as it has been called by Mr. Crace Calvert, has not yet, we believe, been separated and submitted to chemical investigation. It is obtained on the cloth directly by printing with a mixture of aniline salt and chlorate of potash. The cloth is dried, and in about twelve hours the green colour is developed. On boiling in an alkaline solution, or solution of soap, the green becomes blue, or may be changed into black by treating the fabric with a weak solution of bichromate of potash or bleaching powder.

A greenish-black is also produced when a cloth is printed with a mixture of aniline salt and nitrate of copper. Green or bluish colours are, in fact, obtained when aniline is treated in a variety of ways; but, with the exception of the emeraldine mentioned above, none have any industrial importance. Some of the substances, however, deserve further investigation. There is, for example, the green matter obtained by Dr. Letheby and Mr. Coleman, on submitting a solution of sulphate of aniline to electrolysis. When first deposited, this substance has a beautiful fresh bluish-green colour, which, however, soon becomes dull. When submitted to deoxidising agents, as the mixture of lime and sulphate of iron used for preparing colourless indigo, this substance also furnishes a colourless solution, which again becomes of a dull green when exposed to the air. It is insoluble in water, alcohol, and ether, but dissolves in strong sulphuric acid, giving a solution of a permanent dull, dark green colour. So far as we are aware, the composition of the substance is unknown.

A blue of wonderful beauty is, however, obtained from aniline in an indirect way, by heating for a considerable time a salt of rosaniline with an excess of aniline to about 150° or 160° C. The time necessary for the change will vary according to the amounts employed. A mixture of two kilogrammes of hydrochlorate of rosaniline and four kilogrammes of aniline requires four hours. Together with the blue, some violet and other colouring matters are obtained, and a considerable amount of ammonia is evolved. "The crude blue is purified by treating it successively with boiling water, acidulated with hydrochloric acid, and with pure water, until it presents the purest possible hue." From a boiling alcoholic solution it may be obtained in brilliant needles. In a solid state it presents a copper-coloured metallic appearance, almost without any mixture of green or yellow. For the solution of aniline blue, alcoholic or methylic liquids, acidulated with acetic acid, are generally employed. The slight solubility of aniline blue makes its application to dyeing and printing a little more difficult, but the processes used are nearly the same as those for aniline violet.

Mr. Nicholson purifies the colour by dissolving it in concentrated sulphuric acid, and digesting the solution for half an hour at 150° C. When water is afterwards added to the solution, the blue colouring matter is precipitated in a modified condition, in which it is soluble in pure water.

For our knowledge of the chemical nature of this beautiful compound we are again indebted to Mr. Nicholson and the author of this report. They have established that the blue colouring matters are, in fact, salts of a colourless base. When one of these salts is dissolved in alcohol, and the solution added to alcoholic ammonia, the deep blue colour disappears, and a brownish solution is obtained. Water added to this solution causes the colourless base to separate in the form of a curdy precipitate, which gradually assumes a crystalline character; dried *in vacuo* this substance remains colourless, or becomes slightly bluish. Heated to 100° C, it cakes and becomes brownish, and then is found to be composed of,—

$$C_{38}H_{33}N_3O = C_{38}H_{31}N_3,H_2O_2.$$

This formula exhibits an extremely simple relation between aniline red and aniline blue; indeed, aniline blue is triphenylic rosaniline,—

Aniline red $C_{20}H_{19}N_3,H_2O$ Rosaniline
,, blue $C_{20}\begin{bmatrix}H_{16}\\(C_6H_5)_3\end{bmatrix}N_3,{}_2H_2O$ Triphenlyic Rosaniline

The genesis of aniline blue is represented by the following equation :—

$$\underbrace{C_{20}H_{19}N_3,HCl)}_{\text{Hydrochlorate of rosaniline.}} + 3\underbrace{\left[\left.\begin{matrix}C_6H_5\\H_2\end{matrix}\right\} N\right]}_{\text{Aniline.}} = C_{20}\begin{bmatrix}H_{16}\\(C_6H_5)_3\end{bmatrix}N_3,HCl + 3H_3N.$$

Nascent hydrogen and sulphide of ammonium convert aniline blue into a colourless compound corresponding to leucaniline, $C_{38}H_{33}N_3$.

We quote the next paragraph at length :—

"The recognition of the nature of aniline blue has led to some experiments which seem likely to become [have become] of industrial importance. Seeing that the substitution of three atoms of phenyl for three atoms of hydrogen in rosaniline, induces a change from red to blue, the idea naturally suggested itself to replace the hydrogen by other radicals, such as methyl, ethyl, and amyl. Experiment has furnished results of some interest. Rosaniline is readily attacked by the iodides of those radicals; a series of new substances being produced, obviously the salts of trimethyl-, triethyl-, and triamyl-rosaniline, the blue colours of which are similar to that of the phenylated compound."

We shall shortly have to notice the specification of a patent for producing these compounds, which has just been published, so shall not allude to them further at present.

Rosaniline salts, when boiled with aldehyde, or even with crude wood-spirit, assume a permanent blue colour, but the nature of this colouring matter is unknown. Tannate of rosaniline easily undergoes this modification of colour.

Mulhouse blue is made by boiling nitrate of rosaniline with a solution of gum lac and carbonate of soda.

In connection with aniline colours there is only one more matter to which we can allude, and that is the application of the secondary products in the composition of writing and printing inks. The mixture of carbon and oxide of chromium obtained in the manufacture of aniline violet is already extensively used for a printing ink. A writing ink of remarkable permanence was exhibited in the French Department of the Exhibition, which Mr. De la Rue recognised as a secondary product of the manufacture of these colours. More recently, Mr. Dale, of Manchester, has noticed a secondary product of the manufacture of aniline violet by means of chloride of copper, which possesses a black colour, and is able to resist the most powerful chemical agents.

We have now done with the aniline colours. In our notices of this part of the report we have endeavoured to place before our readers a knowledge of the results practically obtained in the manufacture of these remarkable and beautiful compounds, together with the scientific information and suggestions by the Reporter, which may serve to guide an independent experimenter. A new dye is a great prize, and, although the ground is well occupied, there is still hope for well-directed skill.

Lastly, it must be mentioned that aniline has been employed medicinally. Bolley found the vapour of aniline to relieve the irritation caused by the inhalation of chlorine. Salts of aniline have also been administered for several disorders, with results as uncertain as attend the use of most medicines. It is said, however, that patients taking the remedy always acquire an ephemeral blue colouration —a fact, perhaps, of some physiological interest. Aniline itself, it must be remembered, is a strong poison, while the salts (the sulphate has been in general employed) in moderate doses seem to possess no toxic properties.

We have yet to notice the coloured derivatives of naphthaline, chinoline, and phenol.

Annalen de Chimie et de Physique. February, 1864.

The greater part of this number is devoted to physics. Two of Professor Graham's papers are reproduced, "*On Liquid Transpiration*," &c. (1861), and his last contribution "*On the Molecular Mobility of Gases.*" It seems strange that the former contribution should appear at this late date in such an important periodical. M. Athanase Dupré contributes two important communications "*On the Mechanical Theory of Heat*," the second of which merits attention, but unfortunately is not adapted for our columns. A chemical examination of Roquefort cheese is contributed by M. Blondeau. This cheese is stowed away in cellars, where it remains for some time before it acquires the flavour which recommends it to the taste of some people. The changes it undergoes in the cellar in the course of two months will be seen by the following analyses of M. Blondeau :—

Fresh Cheese.

Casein	85·43
Fatty matter	1·85
Lactic acid	0·88
Water	11·84
	100·00

Cheese Two Months in a Cellar.

Casein	43·28
Margarine	18·30
Oleine	14·00
Butyric acid	0·67
Salt	4·45
Water	19·30
	100·00

Thus it is seen that a considerable part of the casein becomes converted into margarine and oleine. M. Blondeau believes the transformation to be due to a mycoderm of the genus Penicillium. The change of casein into butter—which the above proportions of margarine and oleine nearly represents—is remarkable, and leads the author to think that butter is formed in the animal economy at the expense of casein.

M. Le Guen gives a short account of some experiments which go to prove that wolfram up to 2½ per cent. increases the hardness and tenacity of cast iron as well as steel. Beyond this proportion, however, it is prejudicial.

M. Alluard's experiments "*On the Boiling Points of Binary Mixtures of Liquids which Dissolve Mutually in all Proportions*," which are here published at length, we have already alluded to in the notices of the proceedings of the Academy of Sciences.

Examples of Quantitative Analysis for the Use of Students in the Royal Agricultural College, Cirencester. Printed for the College. 1864.

This set of examples will be found extremely useful by all teachers and students of agricultural chemistry. It includes concise but clear instructions for the quantitative analysis of water, manures, and soils, some foods (oil-cake, turnips, mangold, &c.), and also dairy products.

The examples are well chosen, and the methods good, and we can heartily recommend the book to all engaged in the study or practice of analytical chemistry applied to agricultural matters.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

310. Sir John Scott Lillie, Pall Mall, London, "Improvements in apparatus for propulsion by atmospheric pressure."

332. James Webster, Lee Crescent, Birmingham, "Improvements in the preparation of paints or varnishes."

339. Joseph Toussaint, Camden Town, London, "Improvements in the manufacture of cement and artificial stone."

346. Peter Spence, Newton Heath, Lancashire, "Improvements in the manufacture of sulpho-cyanide of ammonium and other sulpho-cyanides."

373. James Hicks, Hatton Garden, London, "An improvement in barometers."

381. Gerard Finch, Clarendon Gardens, Maida Hill, Middlesex, "An improvement in the mode of applying steam or other fluid pressure acting on a piston to produce circular motion."

387. Peter Armand Lecomte de Fontainemoreau, South Street, Finsbury, London, "Certain improvements in the manufacture of methylic ether, and its application to the production of artificial ice."—A communication from Charles Tellier, Passy, near Paris.

403. James Wadsworth, Heaton Norris, Lancashire, "Improvements in the methods of softening or dissolving bone, horn, hair, leather, curriers' shavings, raw hide scraps, wool, woollen rags, or other animal matters."

Notices to Proceed.

2553. Henry Gilbee, South Street, Finsbury, London, "An improved composition for rendering boots and shoes and other similar articles waterproof."—A communication from Louis Poncelot, Rue de la Fidélité, Paris.

2575. Charles Garton, Bristol, and Thomas Hill, Southampton, "Improvements in evaporating, cooling, and melting, and in apparatus employed therein."—Petitions recorded October 20, 1863.

2605. Charles James Pownall, Jermyn Street, Westminster, "Improvements in preparing and cleansing vegetable fibres, and in machinery employed therein."—Petitions recorded October 22, 1863.

2614. Alfred Joseph Martin, Vernon Terrace, Roman Road North, Bow, Middlesex, "An improved burner for burning petroleum, paraffin, or other hydrocarbon oils consuming the smoke without the use of a draught chimney."

2618. Victor Julien Cassaignes, Rue de Rivoli, Paris, "Improvements in the manufacture of the prisms, lenses, and glasses of stereoscopes, and in ornamenting glass."

2620. James Parker, Lilford Road, Camberwell, Surrey, "Improvements in the application of steam combined with air as a motive power, and for other purposes."—Petitions recorded October 23, 1863.

2623. William Betts, Wharf Road, City Road, London, "Improvements in the manufacture of metallic capsules for bottles and similar vessels, and in the apparatus or means for applying or fixing such capsules thereon."

2628. Francis Bryan Baker, Sherwood Street, Nottingham, "Improvements in apparatus used in dressing lace and other textile fabrics, and suitable also to the application of dyes or colouring matters thereto."

2629. James Brown, Aldgate, John Thomas Way and Thomas Mullett Evans, Leadenhall Street, London, "Improvements in preparing cements and varnishes."

2682. John Haworth, Hart Street, Bloomsbury, London, "Improvements in the improved method of conveying electric signals and telegrams without the intervention of any continuous artificial conductor."

2700. William Tasker, jun., Waterloo Ironworks, Upper Clatford, Southampton, "Improvements in the making of safety paper, and in the machinery or apparatus employed therein"—Petitions recorded October 31, 1863.

2945. James Smith, Liverpool, "An improved composition for coating or covering the bottoms of ships."—Petition recorded November 23, 1863.

3044. James Bowron, South Stockton, Yorkshire, and George Robinson, Welbeck Street, Cavendish Square, London, "Improvements in the manufacture of soda and sulphuric acid."—Petition recorded December 3, 1863.

CORRESPONDENCE.

The Word "Radical."

To the Editor of the CHEMICAL NEWS.

SIR,—It appears that the orthography of the word "radical" is gradually undergoing a change, the result of which appears now to be favouring the adoption of the word "radicle." There can be no doubt that the former was held to be the correct mode of spelling in the early days of chemistry; and inasmuch as these words have distinct meanings or definitions assigned to them in the dictionaries, it would be well to decide upon their interpretation and proper mode of spelling before proceeding to employ them as terms in discussing the merits of the various systems of nomenclature which are likely before long to suffer a radical change.

I will mention a few facts. Fownes's "Chemistry" retains the use of the old word "radical," whilst Watts's "Dictionary" sanctions the newer style of spelling. Recent authors have generally adopted the latter; amongst them I notice particularly Drs. Debus, Frankland, Matthiessen, and Playfair, Messrs. Buckton, Erlenmeyer, Foster, Schorlemmer, and Wanklyn. Mr. C. Greville Williams changed his opinion as to the mode of spelling between the dates of April and September, 1862, and adheres to the new word. Dr. Maxwell Simpson and others continue to employ the original "radical."

It would be interesting to know whether we are all agreed as to its exact meaning.—I am, &c., J. S.

March 12, 1864.

Oxygennesis.

To the Editor of the CHEMICAL NEWS.

SIR,—As I am professionally concerned for Mr. J. Robbins in the solicitation of his patent for the very beautiful and simple mode of obtaining oxygen gas, to which he has given the above name, I am naturally anxious that the validity of the patent, when completed, should be unimpeachable; and I am, therefore, desirous of saying a few words in reply to the observations which Dr. Squire appears to have made upon the process in question.

Dr. Squire doubts the value of the patent, because Professor Brodie some years since pointed out that when peroxide of barium was treated with an acid solution of bichromate of potash, oxygen was evolved. This was, however, a matter of mere experiment, and the same result might have been arrived at by simple reasoning upon the reaction of the substances recognised.

It has been repeatedly held, however, that the results obtained in the course of mere experiments do not vitiate a patent afterwards applied for, and under which the invention can be made commercially available. I trust, therefore, that your readers and the public will not be led to infer from Dr. Squire's observations that Mr. Robbins' patent will be untenable, or can be invaded with impunity.

As to the value of a quick and simple mode of obtaining oxygen there can be but one opinion. It will place within the reach of the physician an important therapeutic agent, readily applicable to cases in which its exhibition is known to be desirable, and will, probably, also lead to the employment of oxygen in cases in which its use has not been hitherto suggested or employed.

Now that oxygen can be so readily obtained, might not its agency be tried in cases of suspended animation, and also of poisoning with the neurotic poisons? But this is a matter which must be left to the medical profession.

I am, &c.,
E. P. H. Vaughan.

British and Foreign Patent Agency, 15, Southampton Buildings, Chancery Lane, March 16.

MISCELLANEOUS.

Royal Institution of Great Britain.—Probable arrangements for the Friday evening meetings after Easter, 1864:—

April 8. John Percy, M.D., F.R.S., "On recent Improvements in the Smelting of Iron and the Manufacture of Steel."

April 15. Professor Abel, F.R.S., "On the Chemical History and Application of Gun-cotton."

April 22. Professor Blackie, of Edinburgh, "On Lycurgus."

April 29. Professor Alex. Williamson, F.R.S., "On the Question whether there be any Proof of the Existence of Atoms."

May 6. Professor Roscoe, F.R.S., "On Indium and recent Discoveries in Spectrum Analysis."

May 13. J. Scott Russell, Esq., M.A., F.R.S., "On the Mechanical Nature and Uses of Gun-cotton."

May 20. James Nasmyth, Esq., M.R.I., "On Day and Night in the Moon."

May 27. Reginald S. Poole, Esq., of the British Museum, "On Greek Art, as Illustrated by Coins."

June 3. Professor Frankland, F.R.S.

June 10. Professor Tyndall, F.R.S., M.R.I.

Pharmaceutical Society. — Lectures on the British Pharmacopœia.—Lecture IV. Wednesday evening, March 23, at half-past eight o'clock, by Professor Bentley, M.R.C.S. V. Wednesday evening, April 13, at half-past eight o'clock, by Dr. Attfield, F.C.S. VI. Wednesday evening, April 20, at half-past eight o'clock, by Dr. Attfield, F.C.S.

Hypochlorites and Kaolin in Paper.—There is a very simple mode of determining the presence of these bodies in papers, of which the pulp has not been sufficiently washed. It is to moisten the sheet with a diluted solution of iodide of potassium. If there are hydrochlorites in the paper, a brown spot is formed, more or less dark, by the action of iodine, which produces a blue colour, if the sheet has been sized with starch. Moreover, these papers always give an acid reaction, and an odour more or less sensible of chlorine. The presence of kaolin is also easily shown. A definite weight of the paper, previously dried, is incinerated, and the residue weighed. Paper of good quality ought to leave only 2 per cent. of ash. French filtering paper leaves only 2 decigrammes of residue to 100 grains of dried paper, and good Swedish filtering paper (papier Berzelius) used in chemical analysis leaves, after combustion, only $\frac{1}{500}$th of its weight. Nevertheless, it is now very usual to meet with papers which contain $\frac{1}{6}$th and even $\frac{1}{4}$th of their weight of kaolin. A sample of paper prepared with glycerine, sent to me by M. Bols, a printer at Brussels, gave a residue of near 30 per cent. of mineral substances, consisting chiefly of silica and alumina; ingredients which, by their excessive quantity, justify the term of mineral paper being applied to this manufacture. Some idea of the enormous use of kaolin may be formed when it is known that M. L. Piette, in his talented "Journal des Fabricants de Papier," estimated in 1854 at more than 50,000,000 kilogrammes the quantity of this substance used in the paper-mills of Europe to mix with rags.—(*Dr. Van Den Corput in "Technologist."*)

TABULAR VIEW OF THE CHEMICAL ARTS.

Class.	Group.	Principal Subjects.
I. Calorics.	1. Fuel and Furnaces.	Coal, wood, coke, &c. Reverberatory, blast furnaces, &c.
	2. Warming and ventilation.	Stoves, hot air, steam, water.
	3. Pyrotechny.	Matches, gunpowder, fireworks.
II. Plastics.	1. Pyroplastics.	Glass, enamel.
	2. Pottery.	Brick, earthenware, porcelain.
	3. Hydroplastics.	Lime, mortar, gypsum.
III. Metallurgy.	1. Pyrometallurgy.	Reductions of ores by fire.
	2. Hydrometallurgy.	Galvanoplastics, photography.
IV. Chemics.	1. Salines.	Oil of vitriol, soda, nitre, alum.
	2. Metallosalines.	Metallic salts, pigments.
	3. Pharmaceutics.	Inorganic, organic.
V. Calistics.	1. Textile fabrics.	Bleaching, dyeing, calico printing.
	2. Sheet fabrics.	Paper, leather, caoutchouc, gutta percha.
	3. Adhesives.	Resin, varnish, glue.
VI. Oleics.	1. Oils and Fats.	Extraction and fining, &c.
	2. Saponification.	Soap, essences, perfumery.
	3. Illumination.	Chandlery, gas, burning fluids, lamps, jets.
VII. Sitepsics.	1. Farina, &c.	Starch, flour, sugar.
	2. Fermentation.	Alcohol, wine, beer, vinegar.
	3. Culinary arts.	Preparation and preservation of food.
VIII. Biotechnics.	1. Physiology.	Plants and animals, ashes.
	2. Manures.	Putrefaction, mineral manures.
	3. Products.	Milk, fat, bone, horn.

—*Professor J. C. Booth in the "Technologist."*

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

A Whitelaw.—Received with thanks. Will appear shortly.

H. H.—The Report cannot be obtained separately. The Council very meanly keep it back in order to sell the volume containing all the reports.

A Constant Reader.—Cats will drink prussic acid and milk with avidity. Put half an ounce in a saucerful of milk, and leave it out all night.

J. B.—Makin's or Mitchell's Manual of Assaying.

A Subscriber.—Iron, if present, can be removed by Schwartz's patent process. Have you a chalybeate water?

A Constant Reader writes as follows:—"Required the strength of a solution of chloride of zinc, stated by a French writer to be at 25° of Gay Lussac's areometer?"

Received.—J. A.; C. W. Heaton; Report of the Manchester Scientific Students' Association.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Behaviour of Sulphide of Mercury with Sulphide of Ammonium, by Dr. A. CLAUS.*

DURING a toxological examination by Professor von Babo and myself, we observed that in presence of mercurial oxides the test recommended by von Babo and Fresenius for the discovery of arsenic gave some very peculiar and unusual reactions, which are well worthy of especial notice.

We received two stomachs containing poison, and some boxes of pills called Lange's pills, supposed to possess poisonous properties also; nothing was, however, stated about the symptoms exhibited by the deceased, or the supposed nature of the poison. The examination of the pills proved that, besides calomel, they contained nothing of importance. A portion of the stomach was treated with chlorate of potash and hydrochloric acid, and sulphuretted hydrogen passed through the solution, which produced a dirty grey precipitate; to free this of every trace of organic matter, it was, according to Fresenius, still further treated with nitric and sulphuric acid, and reprecipitated with sulphuretted hydrogen. This precipitate contained a considerable amount of sulphur, but possessed by no means the yellow colour of sulphide of arsenic. To prevent the free sulphur retaining any traces of arsenic, it was treated instead of ammonia with sulphide of ammonium, wherein it proved readily soluble.

Hydrochloric acid produced in this solution again a grey precipitate containing sulphur; this was dried, mixed with dry cyanide of potassium and soda, and fused in an atmosphere of carbonic acid. During this operation, the colder end of the tube became covered with a black sublimate, which could not, however, be taken for arsenic, as it produced no garlic-like odour; neither gave the hydrochloric acid solution when tested in Marsh's apparatus any indications of arsenic. The black sublimate or mirror proved insoluble in hydrochloric acid, but easily so in nitro-hydrochloric acid. This led us to suspect the presence of sulphide of mercury, and a piece of gold leaf introduced into the aqua regia solution proved our suspicion to be correct.

To verify these remarkable reactions, which stand in perfect contradiction to the statements of all scientific works (where sulphide of mercury is stated to be insoluble in sulphide of ammonium), I made some experiments with recently precipitated pure sulphide of mercury, and always found a portion of it soluble in sulphide of ammonium. Acids precipitate it again, and as only small portions of it pass into solution, the precipitate becomes large, mixed with sulphur, and assumes a grey, dirty yellowish colour, which might be mistaken for arsenic. In all my experiments, this precipitate, when fused in an atmosphere of carbonic acid with cyanide of potassium and soda, gave black mirrors of sulphide of mercury, which, by further examination, may easily be distinguished from the arsenical mirror. In the first instance, it is of a deeper black, and far less metallic in lustre; secondly, the arsenical mirror, when chased about in a glass tube, leaves the heated place under the appearance of a bright metallic lustre, and condenses again on the cooler spot with well-defined metallic limits, while the open end of the tube exhales most distinctly the alliaceous smell. The sulphide of mercury mirror is not by any means so volatile, neither does it show any of the above-mentioned characters. The best and most certain distinction is, however, its insolubility in nitric acid, and the amalgamation of the gold leaf in the aqua regia solution.

The circumstance, that in fusing the precipitate with cyanide of potassium and soda no metallic mercury is obtained, may be explained by the excess of sulphur always present in the precipitate; and with regard to its black colour, I may mention that in subliming small quantities of sulphide of mercury we never get a sublimate of the red vermilion colour, but on account of the fine division it usually appears black. I have mentioned before that the only ingredient of importance found in the pills was calomel, and as in the further examination of the stomach it was also proved that death resulted from mercurial poisoning, it remained to explain the poisonous nature of the calomel. Some of the pills were a few years old, and on inspection these were found to contain metallic mercury and corrosive sublimate from spontaneous decomposition of the calomel, the metallic mercury being easily discernible by a simple magnifying glass.

This spontaneous decomposition of calomel into mercury and corrosive sublimate, under certain conditions, bears a most important part in pharmaceutical preparations containing this drug, and the use of pills containing it, when old, should be avoided.

TECHNICAL CHEMISTRY.

Utilisation of Brine—A Practical Application of Dialysis.

MR. WHITELAW, of Glasgow, has recently described the result of a patent process of his own for utilising the brine of salted meat. When fresh meat, he said, had been sprinkled with salt for a few days, it was found swimming in brine. Fresh meat contained more than three-fourths of its weight of water, which was retained in it as in a sponge. But flesh had not the power to retain brine to that extent, and in similar circumstances it absorbed only about half as much saturated brine as of water, so that under the action of salt flesh allowed a portion of its water to flow out. This expelled water, as might naturally be expected, was saturated with the soluble nutritive ingredients of the flesh—it was, in fact, juice of flesh—soup—with all its valuable and restorative properties. In the large curing establishments of this city very considerable quantities of this brine were produced, and thrown away as useless. This was the material to which Mr. Whitelaw has applied the process of dialysis, and he thought with success, for the removal of the salts of the brine, and for the production at a cheap rate of pure fresh extract of meat. His process he stated as follows:—The brine, after being filtered to free it from any particles of flesh or other mechanical impurities it might contain, was then subjected to the operation of dialysis. The vessels or bags in which he conducted the operations might be made of various materials and of many shapes, but whatever might be their material or shape he called them "dialysers." Such an apparatus as the following would be found to answer the purpose:—A square vat made of a framework of iron filled up with sheets of skin or parchment paper in such a way as to be water-tight, and strengthened if necessary by stays or straps of metal. The sides, ends, and bottom being composed of this soft, dialysing material, exposed a great surface to the action of the water contained in an outer vat, in which the dialyser was placed. He found a series of ox bladders fitted with stop-cocks,

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* *Annal. der Chem. und Pharm.*, Feb., 1863, p. 209.

or gutta-percha mouth tubes, and plugs, and hung on rods stretching across and into vats of water, a very cheap and effective arrangement. He could also employ skins of animals, either as open bags or closed, and fitted with stop-cocks, or bags of double cloth, with a layer of soft gelatine interspersed between them. Other arrangements would readily suggest themselves, and might be adopted according to circumstances. But supposing the bladder arrangement was taken, which, he thought, would be found practically the best, being cheap, easily managed, and exposing a great surface to the dialytic action. The bladders were filled with the filtered brine by means of fillers, and hung in rows on poles across, and suspended into vats of water. The water in those vats was renewed once a day, or oftener if required, and he found that actually at the end of the third or fourth day, according to the size of the bladders employed, almost all the common salt and nitre of the brine had been removed, and that the liquid contained in the bladders was pure juice of flesh in a fresh and wholesome condition. The juice as obtained from the "dialysers," might now be employed in making rich soups without any further preparation, or it might be concentrated by evaporation to the state of solid extract of meat. The liquid from the dialysers might be treated in several ways. It might be evaporated in an enamelled vessel to a more or less concentrated state, or to dryness, and in these various conditions packed in tins or jars for sale. It might be concentrated at a temperature of 120°, by means of a vacuum-pan or other suitable contrivance, so as to retain the albumen and other matters in a soluble form. Again, the more or less concentrated liquid might be used along with flour used in the manufacture of meat biscuits. The products he had named were all highly nutritive, portable, and admirably adapted for the use of hospitals, for an army in the field, and for ships' stores. The dialysis of brine might be conducted in salt water, so as to remove the greater portion of its salt, and the process completed in a small quantity of fresh rain or other water. In this way ships at sea might economise their brine, and so restore to the meat in a great measure the nutritive power that it had lost in the process of salting. Thus, then, Mr. Whitelaw obtained an extract of flesh at a cheap rate, from a hitherto waste material. Two gallons of brine yielded one pound of solid extract, containing the coagulated albumen and colouring matter. For the production of the same directly from meat, something like twenty pounds of lean beef would be required. The quantity of brine annually wasted was very great. He believed he was considerably under the truth when he said that in Glasgow alone 60,000 gallons were thrown away yearly. If they estimated one gallon as equal to seven pounds of meat in soup-producing power, then this was equal to a yearly waste of 187 tons of meat without bone. Estimating the meat as worth sixpence per pound, this amounted to a loss of 10,472*l*. In this way the waste over the country must be very great. In the great American curing establishments the brine wasted must be something enormous, as he found that in eight of the Federal States 4,000,000 pigs were slaughtered and cured last season. Mr. Whitelaw concluded by quoting from Gregory and Liebig as to the value and efficacy of extract of meat.

The Production of Sulphur in Italy, by M. P. BIANCHI.

THE sulphur at present produced in Italy amounts to no less than 300,000 tons a-year, the value of which in the rough state is 30,000,000 francs. This yield, which has increased tenfold since 1830, is furnished in great part by Sicily. The quantity produced in Romagna, formerly but small, has since increased to 8000 tons per annum.

During the last ten years great improvements have been introduced in the method of extracting sulphur from its calcareous ganque. It is always obtained by liquefaction by burning a portion of the ore; but this operation formerly performed in small, open, cylindrical furnaces (*calcarelle*) is now effected by simply heaping the stones and covering them with earth as in charcoal burning. These heaps, called *calcaroni*, are of considerable size, often four hundred times larger than the old furnaces. This new mode of operating has the advantage of diminishing the losses occasioned by the production of sulphurous acid, so that the yield of sulphur is increased by one-fifth; besides sulphur can be burnt in this way near houses and gardens, which with the old method was out of the question. Formerly it was burnt only at certain periods of the year, now it can be burnt at any time, so that it is no longer necessary to accumulate large quantities of ore. Finally, the operation, which used to be very frequently fatal to the workmen, is now almost harmless.

Sulphur of Romagna and the Marshes.—At Bologna there is a society called "Société des Mines de Soufre des Romagnes," which possesses eight mines, five in the province of Forli (Romagna) called Firmignano, Luzzena, Fosco, Busea, and Montemamro. The other three, forming part of the province of Urbino and Pesaro, are those of Perticara, Marazzana, and Montecchio.

Most of the sulphur from these workings is refined at Rimini, whence it is carried to the places where it is most in demand, such as Venice, Trieste, Ancona, Lombardy, Tuscany, &c.

This refined sulphur is chiefly used for making sulphuric acid, and lately for the treatment of the vine. Its price, which varies considerably, is, in cakes, from 213fr. 10c. per English ton of 1·015 kilogrammes, and in sticks from 254fr. 35c., put on board vessels in the ports of Rimini and Cesenatico, and delivered at the stations of Rimini and Cesana.

Sulphur from the Neapolitan Provinces.—Sulphur is found here in several places, but in small quantities. It is thus found in the volcanic region of Solfatares, where it exists mixed with clay and other matters, from which it is separated by sublimation, but the yield is insignificant. Small deposits of it are found scattered in the district of Majella, one of which is worked at Santa-Liberata. It has recently been announced that there has been discovered at Civita-Nova a bearing of calcaire impregnated with sulphur, but nothing has been said as to its richness and extent. No more is known of another bearing at Santa-Regina, two miles east of Ariano.

Sulphur of Sicily.—Sulphur exists here in a gypseous bed, layers of which extend over a small portion of the island, from Mount Etna to near Trapani. This formation belongs to a geological epoch which has not yet been positively determined. Here, as in Romagna, it contains, besides gypsum, calcaires and clays, more or less marl. In the first case, the sulphur exists in a state of mixture, sometimes uniformly, sometimes irregularly, sometimes in small parallel veins, and more rarely in the form of crystals; in the latter case it is not unusual to find it associated with *cœlestine*, or sulphate of strontium. In clay, on the contrary, it is found in globular masses, which is also the case in similar bearings in Continental Italy.

There are about fifty mines in Sicily, employing 20,000 workmen. The most productive mines are in the provinces of Caltanisetta and Girgenti; ranging next in importance are those of the provinces of Catana, Palermo, and Trapani. The sulphur is extracted in the manner above described by means of *calcaroni;* the loss during the operation amounts to one-third of the ore. Most of the sulphur is exported in the crude state, but little being refined in the island. In this state it is divided into three qualities, the second and third being subdivided into three other qualities. The yield in 1861 was estimated at about 250,000 tons of commercial sulphur, of which about half was produced by the province of Caltanisetta, a third by Girgenti, 25,000 by Catana, and 20,000 by Palermo; the quantity produced by the province of Trapani is very inconsiderable. Most of the sulphur is exported to France and England.

The price of this product has risen during the last few years; in 1860 it sold in the crude state for from 15 to 20 frs. the ton.—*Moniteur Scientifique*, v. 799. 63.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture VII.—*Thursday, January* 14, 1864.

(Continued from page 139.)

We will now direct attention to the oxides of iron. These oxides play a very important part in the economy of nature.

The first of which I shall speak is protoxide of iron. We know, literally, nothing of this compound in its isolated state. It consists of one equivalent of oxygen and one of iron, and forms the basis of common iron salts. One French observer tells us that he has made it in a particular way, but very few persons have ever seen it. It has a very powerful affinity for oxygen, and passes rapidly into a higher state of oxidation. We can separate it, but it immediately passes into a higher oxide.

The next oxide to which I shall refer is the sesquioxide or peroxide, which, as you will see by-and-by, is a most important compound. It is composed of two equivalents of iron and three of oxygen—Fe_2O_3. It crystallises in the rhombohedral system. The crystal is steel grey. There are some very fine specimens here before you. It has a bright metallic lustre; its powder is always red. When in thin scales it transmits a red light. The specific gravity of the native oxide is from 5 to 5·2. Some specimens of the native oxide—even the massive native red oxide—are slightly magnetic. That is an observation for which we are indebted to G. Rose; and I have had an opportunity of confirming it by specimens of our own. I may state that quite recently red oxide of iron has been prepared, artificially, strongly magnetic. That is a new fact. It is not volatile, and yet it may be a product of volatilisation. The magnificent specular iron ore, for example, is a volcanic product, and it may easily be accounted for. Supposing we have the vapour of sesquichloride of iron, there is no difficulty in accounting for the formation of the sesquioxide of iron in volcanic regions. If that vapour be brought in contact with the vapour of water, we get a deposit of crystallised sesquioxide of iron with the formation of hydrochloric acid. The sesquioxide is infusible, except at very high temperatures, and then not without decomposition. It loses a portion of its oxygen when heated to a very high temperature, and passes to the state of magnetic oxide, which is a lower degree of oxidation. This has been determined experimentally by Rose in a porcelain kiln, and we have also confirmed his observation. The sesquioxide occurs magnificently crystallised in nature. There is one variety in the form of micaceous scales, and another which is amorphous. It may be obtained in various ways. One method is treating or fusing common salt with common green vitriol. Then we get a beautiful variety, very much like some kinds of micaceous iron ore which are found in nature—unctuous and greasy. In fact, any mineralogist who got hold of this artificial kind would say that it was a natural product at once. It may be made by heating together chloride of calcium and sesquioxide of iron. Or it may be formed by heating anhydrous sesquioxide of iron in a slow current of hydrochloric acid; or by heating a solution of chloride of iron with carbonate of soda or lime at 200 or 300 degrees centigrade. It occurs abundantly in nature, sometimes filling lodes, sometimes constituting deposits, and at other times existing in beds. It occurs abundantly in Lancashire and Cumberland, and in various other localities, sometimes constituting enormous masses of ore. Occasionally we find it associated with sulphate of baryta. This is the case at Sharkham Point, near Brixham, Torquay. There is a large lode of it near the Mumbles, at Swansea, from which a considerable quantity has been extracted from time to time. It frequently contains silica in the form of quartz crystallised and diffused through it, and sometimes, or, generally, I may say, a large portion of silicate of alumina as well. Frequently there is a large excess of free silica; and this is a very important consideration for our iron masters. Magnificent crystallised sesquioxide of iron occurs at Elba and in Tuscany. It abounds in Sweden, and not unfrequently accompanies magnetite, or the magnetic oxide of iron. In the last Exhibition were fine specimens illustrative of this fact. It occurs pseudo-morphic after magnetic oxide of iron in Siberia, and also at Lake Superior. It is found pseudo-morphus after iron pyrites, as you may perceive in this specimen. It was iron pyrites, but it has now become sesquioxide of iron, the sulphur disappearing, and oxygen taking its place. It is a puzzle to know exactly how this pseudo-morphism has taken place. If iron pyrites is exposed to the weathering action of the air, it is converted, and must be converted, first of all into a common sulphate of protoxide of iron. That becomes oxidised by exposure to the air, passing to the state of a sulphate of sesquioxide of iron. That sulphate of sesquioxide of iron, by the action of water, decomposes into two salts—an acid salt which would dissolve away, and a more basic salt which would remain. We can easily understand the transformation of iron pyrites under these conditions into a highly basic sulphate, and even into hydrated sesquioxide, because we have only to call into our aid bicarbonate of lime, which frequently occurs in mineral waters. The trace of sulphuric acid might be removed, and the gypsum formed washed away, leaving nothing but hydrated sesquioxide of iron. But the difficulty is to understand how the crystals are converted into the anhydrous sesquioxide of iron, and that difficulty remains to be explained. You will see that there is no difficulty in accounting for this by supposing the crystals to be first converted into hydrated sesquioxide of iron in the manner described, and then exposed to a certain degree of heat, whereby the water of the hydrate may be expelled, and the red oxide left. But that theory will not suffice, because we find certain crystals of hydrated sesquioxide of iron which are partially converted on the outside into red oxide of iron. It is perfectly evident that the temperature sufficient to decompose the hydrate could never have existed when such crystals were formed, because if it had it is impossible to conceive that any nucleus of hydrated sesquioxide of iron should remain. You see what a number of conclusions one can sometimes get out of these apparently little facts—exponent facts, which, I trust, will hereafter be of more use to geologists than they have hitherto been.

The formation of this anhydrous sesquioxide of iron in nature is yet unexplained satisfactorily. We can produce it readily enough in our laboratories by means of heat, but there is no reason for supposing that in the conditions in which it has been produced in nature a high temperature has prevailed, or, at least, that remark applies to many cases of the formation of this mineral.

Brown iron ore is the next substance which I shall bring under your notice. The sesquioxide of iron has the property of combining with water, and forming this substance which is hydrated sesquioxide of iron. It is one of the chief ornaments of mineralogical cabinets. We find it sometimes in beautiful radiating crystals consisting of aggregations of fibres forming mamillary masses. It can be produced without difficulty in a variety of ways, both in the laboratory and in nature. It is easily formed by the action of a current of air upon water containing bicarbonate of iron in solution. The carbonate of iron, as I shall show you hereafter, dissolves in water by the agency of carbonic acid. When air is passed through such a solution the protoxide of iron passes to a higher degree of oxidation; it becomes converted into sesquioxide, and takes up water, and thus hydrated sesquioxide of iron is formed. Sesquioxide of iron occurs abundantly in nature; every chalybeate spring furnishes an example of that. Here is a beautiful specimen which I obtained many years ago from Derbyshire, illustrating the formation of this substance in nature. I do not mean that it is beautiful to look at, but that it is beautiful in point of interest; it is a foliated stalactite — one of those things which one finds hanging down from the tops of caves. It consists of delicate *folia* or leaves. Water containing carbonic acid has no doubt percolated through the roof of the cavern, having passed through matter containing oxide of iron, and thus formed on the outside a lamina or layer of sesquioxide of iron; and in course of time a large stalactite like this, consisting of numerous leaves of sesquioxide of iron, has been produced. Brown iron ore may be derived from the decomposition of iron pyrites in the manner described just now; I have here a specimen illustrating this point: it consists of cubes of iron pyrites which have been converted into brown iron ore. Sometimes a nucleus of iron pyrites remains within, as in the case of this specimen. We see exactly what is taking place here through the weathering action of the air and water upon the pyrites. You will remember that in all such instances sulphate must be formed, and we must call into our aid some other agent by which the sulphuric acid generated may be removed; even by the weathering of the silicate of iron it may be produced. All our trap rocks contain a large amount of silicate of protoxide of iron in combination with other silicates. Take the common basalts, of which we have plenty in Staffordshire, These, by the agency of the air, become converted into a brown soil. The protoxide of iron, existing originally in combination with silica, has, by the conjoint action of the air and moisture, been converted into sesquioxide. All our rocks which contain silicate of protoxide of iron furnish a source of brown iron ore. Brown iron ore results also from the weathering action of moist air upon carbonate of iron. There are many examples of this. Any one who has been down to Hastings, and observed those lumps of iron ore by the seashore, will see that, externally, they present a red ring, which is the result of the weathering action upon these lumps. The carbonic acid escapes in proportion as the protoxide of iron with which it was combined passes to sesquioxide. Some years ago, I dug up some specimens near the remains of an old forge, which had been buried for ages—two or three hundred years, for aught I can tell; and they all present this change in a very remarkable degree. We have extensive lodes in the North of England, consisting of hydrated sesquioxide of iron, which is clearly derived from the decomposition of sparry iron ore. In Exmoor the same change has taken place. Then we have a specimen from Cornwall, in which we have a nucleus of carbonate of iron, and can trace the change most completely. Spathic iron ore is one of the chief sources of this mineral. Brown iron ore exists abundantly in various localities. One of the most remarkable sources of it which I have seen in this country is that near Brixham. Close to it is the lode containing red oxide of iron. Here, just behind Brixham, is an enormous excavation, from which the ore has been taken. It was no doubt washed in former times. It is used extensively as a paint. We have abundant deposits of impure brown iron ores in various parts of England. Some was recently discovered in Northamptonshire; and some of the Oxfordshire iron ore consists essentially of impure brown iron ore, or limonite as it is called. In France and Belgium it is worked for the sake of the iron it contains.

I now propose to bring before you a subject which, I think, will interest you. It has not been brought much forward in this country. It is that of the lake ores which occur in Sweden and Finland. In the Exhibition of 1862 there were two or three fine collections of them. Swedenborg, who has written extensively on metallurgical and mineralogical matters, has described these ores at great length—their mode of occurrence and the extraction of them. Everywhere in Sweden, both north and south, the ore was extracted from the bottom of lakes and rivers. It was designated "lake iron ore" (vena lacustris ferri). That in Angermannia, an old province of Sweden, was described as uneven in shape, or sponge-like, of a brown colour, friable under pressure between the fingers, and in fracture resembling cut leather. It occurred in detached portions of variable form, and sometimes of the width of the palm of the hand, and in round grains of the size of grains of barley or wheat, or even of beans. It was not found far from the shores, and it was reproduced in the course of twenty or thirty years. During summer the ore was collected in boats by means of drags, and during winter it was raked up through holes made in the ice. Through the whole of Smaland are lakes from which this kind of ore was extracted, and converted in furnaces in the usual manner into crude iron. So great was the quantity of this ore in Smaland and the neighbouring provinces, that an ample supply might have been obtained for numerous furnaces; and as Swedenborg quaintly expresses it, "*hic Mars uvidus amat fundos lacuum.*" When dry, it was light and porous, as though it did not contain much metal, and yet it yielded a large quantity. The ore varied greatly in richness and in quality, one kind producing the worst, and another the best description of iron. Such was Swedenborg's description. We have further details, which I may present to you, and I give them on the authority of Sjögréen, a Swede, who published a very excellent pamphlet on the subject, illustrative of the Exhibition specimens. These ores are chiefly found in the lakes and streams in the province of Smaland, and as many as five varieties of them are described. They have a concretionary structure, and are designated according to the resemblance of their particles in form and size to certain familiar objects. Their varieties are:—First *pearl ore.* It yields 45 per cent. of iron, is very hard and heavy, and presents a dark brown, oily, shining fracture. It occurs chiefly on muddy or clayey bottoms Second, *bur ore.* It is called after the head of the burdock. It is somewhat spongy, very light, and seldom yields more than 30 per cent. of iron. It breaks easily, and crumbles on drying. It is frequently found on grassy bottoms. Third, *money ore.* It is in small, round, coin-like cakes. We have some of it here. It is more dense than either of the first two. In fracture it resembles the fracture of pearl ore. It yields as much as 40 per cent. of iron. Fourth, *cake ore.* It is in the form of round cakes of from two to six inches in diameter. It is soft, and very light. Its colour is dark grey. It is considered very poor, not containing more than 25 per cent. of iron, and is consequently seldom employed.

It is found on gravelly or clayey bottoms. Fifth, *gunpowder ore.* It is in grains, varying in colour from greenish-yellow to shining black. It is very heavy when pure, and may yield as much as 50 per cent. of iron. It is well adapted for producing iron suitable for castings. It rests on a bottom of fine sand, which it is sometimes nearly impossible to separate from the ore after it has been taken out from the lake. Lake ores are always more or less intermixed with impurities, of which the chief is sand, sometimes to the amount of 30 or 40 per cent. They contain from 20 to 60 per cent. of sesquioxide of iron, and protoxide of iron and manganese, as much as 10 per cent. of silica, from $\frac{1}{20}$th to 4 per cent. of phosphoric acid, and from about 7 to 30 per cent. of hydroscopic water. At one place lake ore was found which contained as much as 20 per cent. of manganese. These ores are universally found in the neighbourhood of reed-banks, and on the slopes of the shallows, in the larger and deeper lakes, in layers from 10 to 200 yards in length, from 5 to 15 yards in breadth, and from 8 to 30 inches in thickness. They never occur in strong currents of water. The same variety is never met with throughout the whole stream; thus, as a rule, gunpowder ore will be found at the beginning, then pearl ore, and, lastly, money and cake ore. Within a short time lake ore is reproduced. We can watch its formation and reproduction. There are instances of lakes where the ore, after having been completely exhausted, collected again in the course of twenty or thirty years to such a degree as to form beds of several inches in thickness. The ores are supposed by some to be of infusorial origin. These are not the bog iron ores, but the lake ores. The bog ore is something quite distinct from the lake ore. The mode of collecting the lake ores will interest you, I think. During the autumn, when the lakes are becoming ice-bound, the collector begins to search for ore. With this view, he introduces a long pole through little holes made in the ice along the slopes of the shallows, and gently strikes the bottom, when, partly by the sound and partly by the touch, he ascertains whether ore is present or not; and he requires long practice in order to perform this work with success. The ore collector marks the boundaries of the bed of ore which he thus discovers with little twigs stuck in the ice, and so acquires legal possession of it. In this manner he marks out as many places as he purposes to work during the winter. When the ice is strong enough, he makes a hole in it about three feet in diameter at the outer boundary of the marked claim, and, through this hole, lets down to the bottom a riddle of perforated iron plate fixed to a long pole. Then, by the use of an iron rake about two feet broad, also fixed to a pole, he collects the ore into a heap at the bottom, and with another rake about six inches broad he fills the riddle, which is taken out and emptied of its contents upon the ice. The ore in this state is mixed with mud, and clay, and sand, and, in order to separate these, it is put into an iron riddle, which is sunk two or three inches below the surface of the water and receives a rocking motion, whereby the impurities pass through, leaving the ore comparatively pure. Two men are generally associated in this work—one being employed in collecting, and the other in washing the ore. If the ore is tolerably plentiful, a man generally collects from half a ton to a ton in a day; but this will obviously depend, not only on his skill, but also on the nature of the ore and the character of the bottom of the lake. In the province of Smaland, during the greater part of the winter, the occupation of ore-collecting is extensively carried on. In 1860, the amount of ore raised in Sweden was about 22,000 tons. I have a number of original analyses of these lake ores from Sweden, which I obtained a short time ago. I shall not trouble you with the details of them all. They are essentially impure hydrated sesquioxide of iron. The following is a selection from these analyses:—

	Lake Ores.		
	From Neij, Calmare County.	From Hulingen, Calmare County.	From Orssjö, Kronobergs County.
PO_5 . . .	1·128	0·701	0·434
SO_3 . . .	trace.	trace.	trace.
CaO . . .	0·823	0·615	0·677
MgO . . .	0·149	0·162	0·135
Al_2O_3 . . .	5·088	7·894	2·167
SiO_3 . . .	7·146	7·376	10·697
Fe_2O_3 . . .	65·576	68·823	57·081
Mn_2O_3 . . .	3·871	0·640	16·185
Water, organic matter, and loss .	16·219	13·789	12·924

We find in them a little alumina and a little magnesia, as we might expect, and also a little lime. They contain, on the average, about 60 per cent. of sesquioxide of iron, and some contain even 68 or 69 per cent. They all contain more or less of manganese. Water is present in them all—water of combination, of course, as well as the hygroscopic water which is present when they are first obtained. Phosphoric acid is found in every case, but, as far as I can make out, they appear to contain less of it than bog iron ores. From the analyses before me, the maximum of the phosphoric acid is 1·128 per cent., and the minimum is 0·168 per cent.

If we conceive a thick bed of gunpowder ore, extending over a large area, and consolidated and agglutinated by some means—it may be by carbonate of iron, or it may be by silica—so as to form a compact mass, it strikes me that we should get such a bed as we are now finding in Cleveland, and which presents an öolitic structure; and I imagine that such a bed as I have supposed would present an öolitic structure like some of the Cleveland iron ores.

I have next to bring before you another oxide of iron. We have spoken of the protoxide, and we have spoken of the peroxide. We will now speak of the combination of the two, or what is supposed to be a combination of the two—namely, magnetic oxide of iron. This is a great subject, and one of extreme difficulty, in many respects, to geologists and others. This magnetic oxide of iron has played a marvellous part in the economy of nature. It may be regarded as composed of one equivalent of protoxide of iron and one of sesquioxide of iron, so that it consists of three equivalents of iron and four of oxygen. It crystallises in the cubical system. In nature it occurs magnificently crystallised, and sometimes, also, massive. It is a product of various metallurgical operations. Here is a magnificent specimen of crystallised magnetic oxide of iron from chloritic schist, the crystals standing out in a state of great distinctness. In furnace operations we obtain crystals in the same state—sometimes beautifully distinct. It is by no means an uncommon product. I have a specimen of the artificial mineral to which I wish to call your attention particularly. It is a very beautiful specimen, in dodecahedral crystals exactly resembling a Traversella specimen. The artificial mineral in this form is exceedingly rare. I have seen only one specimen. When you examine it in contact with the natural mineral you can hardly recognise the difference.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, January 22, 1864.

On Boiling Water,

By W. Grove, Esq., Q.C., F.R.S., M.R.I.

A paper by M. Donny ("*Mémoires de l'Académie Royale de Bruxelles,*" 1843) makes known the fact that in proportion as water is deprived of air, the character of its ebullition changes, becoming more and more abrupt, and boiling like sulphuric acid with *soubresauts*, and that between each burst of vapour the water reaches a temperature above its boiling point. To effect this, it is necessary that the water be boiled in a tube with a narrow orifice, through which the vapour issues; if it be boiled in an open vessel it continually reabsorbs air and boils in the ordinary way.

In my experiments on the decomposition of water by heat, I found that with the oxy-hydrogen gas given off from ignited platinum plunged into water, there was always a greater or less quantity of nitrogen mixed; this I could never entirely get rid of, and I was thus led into a more careful examination of the phenomenon of boiling water, and set before myself this problem—what will be the effect of heat on water perfectly deprived of air or gas?

Two copper wires were placed parallel to each other through the neck of a Florence cask, so as nearly to touch the bottom; joining the lower ends of these was a fine platinum wire, about an inch and a-half long, and bent horizontally into a curve. Distilled water, which had been well boiled and cooled under the receiver of an air-pump, was poured into this flask so as to fill about one-fourth of its capacity. It was then placed under the receiver of an air-pump, and one of the copper wires brought in contact with a metallic plate covering the receiver, the other bent backwards over the neck of the flask, and its end made to rest on the pump plate. By this means, when the terminal wires from a voltaic battery were made to touch, the one the upper and the other the lower plate, the platinum wire would be heated, and the boiling continued indefinitely in the vacuum of a very excellent air-pump. The effect was very curious; the water did not boil in the ordinary manner, but at intervals a burst of vapour took place, dashing the water against the sides of the flask, some escaping into the receiver. (There was a projection at the central orifice of the pump-plate to prevent this overflow getting into the exhausting tube.)

After each sudden burst of vapour, the water became perfectly tranquil, without a symptom of ebullition until the next burst took place. These sudden bursts occurred at measured intervals; so nearly equal in time that, had it not been for the escape from the flask, at each burst, of a certain portion of water, the apparatus might have served as a timepiece.

This experiment, though instructive, did not definitely answer the question I had proposed, as I could not of course ascertain whether there was some minute residuum of gas which would form the nucleus of each ebuillition; and I proceeded with others. A tube of glass, 5 feet long and $\frac{4}{10}$ths inch internal diameter, was bent into a V-shape; into one end a loop of platinum wire was hermetically sealed with great care, and the portion of it in the interior of the tube was platinised. When the tube had been well washed, distilled water, which had been purged of air as before, was poured into it to the depth of 8 inches, and the rest of the tube filled with olive oil; when the V was inverted, the open end of the tube was placed in a vessel of olive oil, so that there would be 8 inches of water resting on the platinum wire, separated from the external air by a column of 4 feet 4 inches of oil. The projecting extremities of the platinum wire were now connected with the terminals of a voltaic battery, and the water heated; some air was freed and ascended to the level of the tube—this was made to escape by carefully inverting the tube so as not to let the oil mix with the water—and the experiment continued. After a certain time the boiling assumed a uniform character, not by such sudden bursts as in the Florence flask experiment, but with larger and more distinct bursts of ebullition than in its first boiling.

The object of platinising the wire was to present more points for the ebullition, and to prevent *soubresants* as much as possible.

The experiment was continued for many hours, and in some repetitions of it for days. After the boiling had assumed a uniform character, the progress of the vapour was carefully watched, and as each burst of vapour condensed in the oil, which was kept cool, it left a minute bead of gas, which ascended through the oil to the bend of the tube: a bubble was formed here which did not seem at all absorbed by the oil. This was analysed by a eudiometer, which I will presently describe, and proved to be nitrogen. The beads of gas, when viewed through a lens and micrometer scale at the same height in the tube, appeared as nearly as may be of the same size. No bubble of vapour was condensed completely, or without leaving this residual bubble. The experiment was frequently repeated, and continued until the water was so nearly boiled away that the oil, when disturbed by the boiling, nearly touched the platinum wire; here it was necessarily stopped.

To avoid any question about the boiling being by electrical means, similar experiments were made with a tube, without a platinum wire, closed at its extremity, and the boiling was produced by a spirit lamp. The effects were the same, but the experiment was more difficult and imperfect, as the bursts of vapour were more sudden, and the duration of the intervals more irregular.

The beads of gas were extremely minute, just visible to the naked eye, but were made visible to the audience by means of the electric lamp.

In these experiments there was no pure boiling of water—*i.e.*, no rupture of cohesion of the molecules of water itself, but the water was boiled, to use M. Donny's expression, by evaporation against a surface of gas.

It is hardly conceivable that air could penetrate through such a column of oil, the more so as the oil did not perceptibly absorb the nitrogen freed by the boiling water and resting in the bend of the tube; but to meet this conjectural difficulty, the following experiment was made:—A tube, 1 foot long and $\frac{2}{10}$ths inch internal diameter, bent into a slight angle, had a bulb of $\frac{3}{4}$-inch diameter blown on it at the angle; this angle was about three inches from one end and 9 from the other; a loop of platinum wire was sealed into the shorter leg, and the whole tube and bulb filled with and immersed into mercury; water, distilled and purged of air as before, was allowed to fill the short leg, and by carefully adjusting the inclination, the water could be boiled so as to allow bubbles to ascend into the bulb and displace the mercury. The effect was the same as with the oil experiment, no ebullition without leaving a bead of gas; the gas collected in the bulb, and was cut off by what may be termed a valve of mercury, from the boiling water, then allowed to escape, and so on; the experiment was continued for many days, and the bubbles analysed from time to time; they proved, as before, to be nitrogen; and, as before, continued indefinitely.

A similar experiment was made without the platinum wire, and though, from the greater difficulties, the experiment was not so satisfactory, the result was the same.

As the mercury of the common barometer will keep air out of its vacuum for years, if not for centuries, there could be no absorption here from the external atmosphere, and I think I am fairly entitled to conclude from the above experiments—which I believe went far beyond any that have been recorded—that no one has yet seen the phenomenon of pure water boiling—*i.e.*, of the disruption of the liquid particles of the oxy-hydrogen compound so as to produce vapour which will, when condensed, become water, leaving no permanent gas. Possibly, in my experiment of the decomposition of water by ignited platinum, it may be that the sudden application of intense heat, and in some quantity, so forces asunder the molecules that, not having sufficient nitrogen dissolved to supply them with a nucleus for evaporation, the integral molecules are severed, and decomposition takes place. If this be so, and it seems to me by no means a far-fetched theory, there is probably no such thing as boiling, properly so called, and the effect of heat on liquids in which there is no dissolved gas may be to decompose them.

Considerations such as these led me to try the effect of boiling on an elementary liquid, and bromine occurred as the most promising one to work upon; as bromine could not be boiled in contact with water, oil, or mercury, the following plan was ultimately devised:—A tube, 4 feet long and $\frac{4}{10}$ths inch diameter, had a platinum loop sealed into one closed extremity; bromine was poured into the tube to the height of 4 inches; the open end of the tube was then drawn out to a fine point by the blow-pipe, leaving a small orifice; the bromine was then heated by a spirit-lamp; and when all the air was expelled, and a jet of bromine vapour issued from the point of the tube, it was sealed by the blow-pipe. There was then, when the bromine vapour had condensed, a vacuum in the tube above the bromine. The platinum loop was now heated by a voltaic battery, and the bromine boiled: this was continued for some time, care being taken that the boiling should not be too violent. At the end of a certain period—from half an hour to an hour—the platinum loop gave way, being corroded by the bromine; the quantity of this had slightly decreased. On breaking off, under water, the point of the tube, the water mounted, and showed a notable quantity of permanent gas, which on analysis proved to be pure oxygen. As much as a quarter of a cubic inch was collected at one experiment. The platinum wire, which had severed at the middle, was covered with a slight black crust, which, suspecting to be carbon, I ignited by a voltaic spark in oxygen in a small tube over lime-water; it seemed to give a slight opalescence to the liquid, but the quantity was so small that the experiment was not be relied on. No definite change was perceptible in the bromine; it seemed to be a little darker in colour, and had a few black specks floating in it, which I judged to be minute portions of the same crust which had formed on the platinum wire, and which had become detached.

The experiment was repeated with chloride of iodine, and with the same result, except that the quantity of oxygen was greater: I collected as much as half a cubic inch in some experiments, from an equal quantity of chloride of iodine, the platinum wire, however, was more quickly acted on than with the bromine, and the glass of the tube around it to some extent.

Melted phosphorus was exposed to the heat of the voltaic disruptive discharge by taking this between platinum points in a tube of phosphorus, similarly to an experiment of Davy's, but with better means of experimenting; a considerable quantity of phosphuretted hydrogen was given off, amounting in several experiments to more than a cubic inch.

A similar experiment was made with melted sulphur, and sulphuretted hydrogen was given off, but not in such quantities as the phosphuretted hydrogen. I tried in vain to carry on these experiments beyond a certain point; the substance became pasty, mixed with platinum from the arc, and from the difficulty of working with the same freedom as when they were fresh, the glass tubes were always broken after a certain time. Had I time for working on the subject now, I should use the discharge from the Ruhmkorf coil, which had not been invented at the period of these experiments. At a subsequent period, when this discharge was taken in the vacuous receiver of an air-pump from a metallic point to a metallic capsule containing phosphorus, a considerable yellow deposit lined the receiver, which, on testing, turned out to be allotropic phosphorus. No gas is, however, given off. I had an air-pump (described "Phil. Trans.," 1852, p. 101) which enabled me to detect very small quantities of gas, but I could get none. It was in making these experiments that I first detected the striæ in the electric discharge, which have since become a subject of such interesting observations, which are seen, perhaps, more beautifully in this phosphorus vapour than in any other medium, and which cease, or become very feeble, where the allotropic phosphorus is not produced.

I tried also phosphorus highly heated by a burning-glass in an atmosphere of nitrogen, but could eliminate no perceptible quantity of gas, though the phosphorus was changed into the allotropic form.

It is not difficult to understand why gas is not perceptibly eliminated in the last two experiments; the effect is probably similar to that described in my paper on the "*Decomposition of Water by Heat*," where when the arc or electric spark is taken in aqueous vapour, a minute bubble of oxyhydrogen gas is freed and disseminated through the vapour, recombination being probably prevented by this dilution; but, however long the experiment may be continued, no increased quantity of the gas is obtained, all beyond this minute quantity being recombined. If, however, the bubble of gas be collected, by allowing the vapour to cool, and then expelled, a fresh portion is decomposed, and so on.

So with the phosphorus in the experiments in the air-pump and with the burning-glass; if any gas is liberated it is probably immediately recombined with the phosphorus; possibly a minute residium might escape recombination, but the circumstances of the experiment did not admit of this being collected, as the gas was with the aqueous vapour.

When, on the other hand, the gas freed is immediately cut off from the source of heat, as when the spark is taken in liquids, an indefinite quantity can be obtained.

Decomposition and the elimination of gas may thus take place by the application of intense heat to a point in a liquid, or also in gas or vapours; but in the latter case it is more likely to be masked by the quantity of gas or vapour through which it is disseminated.

I believe there are very few gases in which some alteration does not take place by the application of the intense heat of the voltaic arc or electric spark. If the arc be taken between platinum points in dry oxygen-gas over mercury, the gas diminishes indefinitely, until the mercury rises, and by reaching the point where the arc takes place, puts an end to the experiment. I have caused as much as a cubic inch of oxygen to disappear by this means. I at one time thought this was due to the oxidation of the platinum; but the high heat renders this improbable, and the deposit formed on the interior of the glass tube in which the experiment is made has all the properties of platinum-black; so if the spark from a Ruhmkorf coil be taken in the vapour of water for several days, a portion of gas is freed which is pure hydrogen, the oxygen freed being probably changed into ozone, and dissolved by the water in this case, while in the former it combined with the mercury.

I have alluded to the eudiometer by which I analysed the gases obtained in these experiments; it was formed simply of a tube of glass, frequently not above $2\frac{1}{2}$ millimetres in diameter, with a loop of wire hermetically sealed into one end, the other having an open bell mouth. By a platinum wire a small bubble of the gas to be examined could be got up through water or mercury into the closed end of the tube, and by the addition of a bubble of oxygen or hydrogen gas, a very accurate analysis of very minute quantities of gas could be made: I have analysed by this means quantities no larger than a partridge-shot.

I need hardly allude to results on the compound liquids, such as oils and hydrocarbons, as the fact that permanent gas is given off in boiling such liquids would not be unexpected; but the above experiments seem to show that boiling is by no means necessarily the phenomenon that has generally been supposed, viz., a separation of cohesion in the molecules of a liqnid from distension by heat. I believe, from the close investigation I made into the subject that (except with the metals, on which there is no evidence) no one has seen the phenomenon of pure boiling without permanent gas being freed, and that what is ordinarily termed boiling arises from the extrication of a bubble of permanent gas either by chemical decomposition of the liquid, or by the separation of some gas associated in minute quantity with the liquid, and from which human means have hitherto failed to purge it; this bubble once extricated, the vapour of the liquid expands it, or, to use the appropriate phrase of M. Donny, the liquid evaporates against the surface of the gas.

My experiments are, in a certain sense, the complement of his. He showed that the temperature of the boiling point was raised in some proportion as water was deprived of air, and that under such circumstances the boiling took place by *soubresauts.* I have, I trust, shown that when the vapour liberated by boiling is allowed to condense, it does not altogether collapse into a liquid, but leaves a residual bubble of permanent gas, and that at a certain point this evolution becomes uniform.

Boiling, then, is not the result of merely raising a liquid to a given temperature, it is something much more complex.

One might suppose that with a compound liquid the initial bubble by which evaporation is enabled to take place might, if all foreign gas were or could be extracted, be formed by decomposition of the liquid: but this could not be the case with an elementaay liquid; whence the oxygen from bromine or the hydrogen from phosphorus and sulphur? As with the nitrogen in water, it may be that a minute portion of oxygen, hydrogen, or of water is inseparable from these substances, and that if boiled away to absolute dryness, a minute portion of gas would be left for each ebullition.

With water there seems a point at which the temperature of ebullition and the quantity of nitrogen yielded become uniform, though the latter is excessively minute.

The circumstances of the experiments with bromine, phosphorus, and sulphur did not permit me to push the experiment so far as was done with water, but as far as it went the result was similar.

When an intense heat, such as that from the electric spark or voltaic arc, is applied to permanent gas, there are, in the greater number of cases, signs either of chemical decomposition or of molecular change; thus compound gases, such as hydrocarbons, ammonia, the oxides of nitrogen, and many others are decomposed. Phosphorus in vapour is changed to allotropic phosphorus, oxygen to ozone, which, according to present experience, may be viewed as allotropic oxygen. There may be many cases where, as with aqueous vapour, a small portion only is decomposed, and this may be so masked by the volume of undecomposed gas as to escape detection. If, for instance, the vapour of water were incondensable, the fact that a portion of it is decomposed by the electric spark or ignited platinum would not have been observed.

All these facts show that the effect of intense heat applied to liquids and gases is much less simple, and presents greater interest to the chemist, than has generally been supposed. In far the greater number of cases, possibly in all, it is not mere expansion into vapour which is produced by intense heat, but there is a chemical or molecular change. Had circumstances permitted, I should have carried these experiments further, and endeavoured to find an *experimentum crucis* on the subject. There are difficulties with such substances as bromine, phosphorus, &c., arising from their action on the substances used to contain and heat them, which are not easy to vanquish, and those who may feel inclined to repeat my experiments will find these difficulties greater than they appear in narration; but I do not think they are insuperable, and hope that, in the hands of those who are fortunate enough to have time at their disposal, they may be overcome.

To completely isolate a substance from the surrounding air, and yet be able to experiment on it, is far more difficult than is generally supposed. The air-pump is but a rude mode for such experiments as are here detailed. Caoutchouc joints are out of the question. Even platinum wires carefully sealed into glass, though, as far as I have been able to observe, forming a joint which will not allow gas to pass, yet it is one through which liquids will effect a passage, at all events, when the wires are repeatedly heated.

In some experiments with the ignited platinum wire hermetically sealed into a tube of glass, the end of the tube containing the platinum wire was placed in a larger tube of oil, to lessen the risk of cracking the glass. After some days' experimenting, though the sealing remained perfect, a slight portion of carbon was found in the interior liquid. This does not affect the results of my experiments, as I repeated them with glass tubes closed at the end and without platinum wires, and also without the oil bath; but it shows how difficult it is to exclude sources of error. When water has been deprived of air to the greatest practicable extent it becomes very avid for air. The following experiment is an instance of this:—A single pair of the gas battery, the liquid in which was cut off from the external air by a greased glass stopper, having one tube filled with water, the other with hydrogen; the platinised platinum plates in each of these tubes were connected with a galvanometer, and a deflection took place from the reaction of the hydrogen on the air dissolved in the water. After a time the deflection abated, and the needle returned to zero, all the oxygen of the air having become combined with the hydrogen. If now the stopper were taken out, a deflection of the galvanometric needle immediately took place, showing that the air rapidly enters the water as water would a sponge. Absolute chemical purity in the ingredients is a matter, for refined experiments, almost unattainable. The more delicate the test, the more some minute residual product is detected. It would seem (to put the proposition in a somewhat exaggerated form) that in nature everything is to be found in anything if we carefully look for it.

I have indicated the above sources of error to show the close pursuit that is necessary when looking for these minute residual phenomena. Enough has, I trust, been shown in the above experiments to lead to the conclusion that hitherto simple boiling, in the sense of a liquid being expanded by heat into its vapour without being decomposed or having permanent gas eliminated from it, is a thing unknown. Whether such boiling *can* take place may be regarded as an open question, though I incline to think it cannot; that if water, for instance, could be absolutely deprived of nitrogen, it would not boil until some portion of it was decomposed; that the physical severance of the molecules by heat is also a chemical severance. If there be anything in this theoretic view, there is great promise of important results on elementary liquids, if the difficulties to which I have alluded can be got over.

The constant appearance of nitrogen in water, when boiled off out of contact with the air almost to the last drop, is a matter well worthy of investigation. I will not speculate on what possible chemical connection there may be between air and water. The preponderance of these two substances on the surface of our planet, and the probability that nitrogen is not the inert diluent in respiration that is generally supposed, might give rise to not irrational conjectures on some unknown bond between air and water. But it would be rash to announce any theory on such a subject; better to test any guess one may make by experiment than to mislead by theory without sufficient data, or to lessen the value of facts by connecting them with erroneous hypotheses.

ACADEMY OF SCIENCES.

March 14.

The early day on which we are compelled to go to press obliges us to notice very shortly the proceedings of the Academy. A memoir entitled "*Researches on the Respira-*

tion of Fruits," by M. Cahours, was read, to which we shall have to direct further attention. At present we can only say that the author finds no gases but carbonic acid and nitrogen in fruits. M. Scheurer-Kester sent a continuation of his "*Researches on Le Blanc's Process*," which we shall translate at length. M. Kekulé contributed an interesting letter on the "*Atomicity of Elements*," in answer to the opinions of M. Naguet before referred to. We shall give both these communications in our next. M. Girard sent a short note on the "*Difficulty of Separating Sulphates by means of Alcohol.*" When free sulphuric acid is to be estimated in the presence of sulphates, some one (*on*) has recommended that the latter should be precipitated by means of alcohol, and the free acid determined after evaporation. But M. Girard has discovered for himself that some sulphates are slightly soluble in alcohol, and hence exact results are not obtained by the method. The above, probably, is not the process our readers would adopt; but the author's experience is worth having.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. HOFMANN, F.R.S., LL.D., &c., &c.

(SEVENTEENTH NOTICE.)

(*Continued from page 142.*)

THE magnificent blue dye obtained by the action of iodide of amyl on the chinoleïne derived from cinchonine has been described in our pages by the discoverer, Mr. C. G. Williams. Our readers will find a detailed account of the process at page 219, vol. ii., of the CHEMICAL NEWS. "This colouring matter," says the Report, "perhaps the most beautiful known up to the present time, is, unfortunately, so fugitive and so easily acted on by light, that it is destroyed in a very short time. It is much to be regretted that no one has yet succeeded in giving more stability to the chinoleine blue, as the silk stuff dyed with this colouring matter, which exhibit a superb blue by day, reflect violet tints of extraordinary beauty by candle or gas-light." To this we may add, that the *Société Industrielle de Mulhouse* has offered a gold medal and a prize of 10,000f. for the discovery of a method of rendering the colour permanent.

Cyanine, as the colour has been named, may be obtained in the crystalline state, as well-formed prisms, which reflect a green metallic lustre with a golden tint. They are very slightly soluble in water, but dissolve readily in alcohol. The solution is of a magnificent blue colour, with a coppery iridescence on the surface. Acids destroy the colour, while ammonia and caustic alkalies leave it apparently unchanged, but in reality separate it as a finely-divided precipitate floating in a colourless solution.

Dr. Hofmann analysed these green crystals, and found them to consist of "a mechanical mixture of two iodides represented respectively by the formulæ—

$$C_{28}H_{35}N_2I, \text{ and}$$
$$C_{30}H_{39}N_3I,$$

the latter predominating almost to the exclusion of the former." We need not quote further on the chemistry of these interesting compounds, as the reader will find Dr. Hofmann's paper on the subject at page 85, vol. vii., of the CHEMICAL NEWS.

A blue colour, to which the name azuline has been given, is obtained from carbolic acid. The process, patented by MM. Guinon, Marnas, and Bonnet, is shortly as follows:—Ten parts of carbolic acid are heated with from four to eight parts oxalic acid and four parts sulphuric acid, until the colour and consistence of the mixture indicate the operation finished. The product is then washed with water to remove the excess of acid, when a green paste is left behind. One part of this paste is now heated in a digester with two and a-half parts of commercial ammonia for three hours to 150° C. In this way a dense red coloured solution is obtained which will dye silk and wool red. To this red dye the discoverers give the name *péonine*. In order to obtain the blue azuline five parts of péonine are heated for several hours with six or eight parts of aniline. There is a little mystery in the description of the process here, which the learned author of the Report cannot clear up. It is not said whether the péonine is to be used dry or in paste, nor is the temperature stated to which the mixture with aniline is to be submitted. However, if the process be conducted successfully, a blue colouring matter is obtained which can be purified by washing with hot coal gas naphtha and caustic alkalies. Then, after washing with acidulated water and drying, the azuline is obtained as a fine powder with a golden lustre, soluble in wood-spirit and common alcohol, the solution being at once applicable to dyeing and printing. When applied to silk, however, the bath is acidulated with a little sulphuric acid.

Picric acid is another colouring matter derived from phenol, as all our readers know, by the action of nitric acid. We need not describe the process for its manufacture, but it may be new to some to know that the best way of separating the acid from the tarry matter of the crude product is to convert it into a salt—say of soda—taking care to avoid an excess of the alkali, and then, after filtration, to decompose the picrate of soda at a boiling heat, with an excess of sulphuric acid. The picric acid thus separated is nearly insoluble in the mother liquors, and crystallises out as the liquor cools almost chemically pure.

The uses of picric acid itself as a yellow dye are too well known to need description here. It promises, however, to furnish another series of red, purple, and blue dyes; for each of these colours is produced by the action of reducing agents—red, with a ferrous salt and an alkali; purple, with cyanide of potassium and ammonia; and blue, with stannous chloride. Very little is known of these colours, and no one has yet received any practical application.

Naphthaline colours are very briefly noticed in the report. *Naphthazarin*, the substance like alizarine, is remarkable; but unfortunately it dyes a very dull colour, and therefore receives no industrial application.

We have now finished with the coal-tar colours. The space to which our notices have extended oblige us to omit much; but we cannot forbear quoting the eloquent conclusion to this section of the report, for the sake of the moral it inculcates:—

"——— only four [now five] years ago, aniline and its derivations were spoken of by an able writer in the following terms:—'The compounds of aniline are to be reckoned by hundreds; *but they are not the subjects of manufacture; they are not articles of commerce; they are of no use in the arts; they are applied to no use in domestic economy*,' &c. How great the difference between this opinion and the verdict of wondering applause and admiration now pronounced in its favour by the thousands who daily crowd to see at the Exhibition the radiant beauty of its marvellous derivatives!

"Yes! it is not too much to say that the history of the chromatic derivatives of aniline, phenol, naphthaline, and other coal-tar products, is a splendid demonstration of the power and utility of chemistry. But this history teaches us another and a nobler lesson still, and one which, in closing this section, the reporter would once more recall; for it is apt to be forgotten in a great industrial country like England, where fortune ever tempts the chemist from the hard mountain path of pure scientific research to the smiling slopes of lucrative industrial application. That lesson, based on the discovery of benzol, and pointing to the illustrious name of its discoverer, FARADAY, bids us, if we would reach the noblest heights of fame, to seek PURE TRUTH; careless of industrial advantage to ourselves, yet sure that from our labours practical good will in due season flow, for the benefit of all mankind."

Some common-place reflections are suggested by the above; but we must leave the reader to make them for himself.

We have now nearly done with this report; but we cannot leave this section without again expressing our thanks to the learned author whose labours have given to the book an interest far more lasting than that which generally attaches to a work of the kind.

CORRESPONDENCE.

Purification of Oxalic Acid.

To the Editor of the Chemical News.

Sir,—Will you allow me to make known in your columns the results of some experiments on the purification of oxalic acid in which I was engaged when I received your number for February 6, containing M. Maumené's method of obtaining this acid practically pure?

Following, as I thought, the directions of Mohr quoted by Fresenius ("Quantitative Analysis," p. 90), I found, with M. Maumené, that the more frequent the crystallisations the richer the crystals grew in impurity, indicated by ignition. As these directions are to leave a large quantity of the acid undissolved by luke-warm water, the author was no doubt quite aware of the difficulties to be overcome, and relied on the acid oxalates being left undissolved. I may have dissolved these up by using water in too great quantity, or of too high a temperature; however this may be, despairing of the whole process, I dissolved all the crops of crystals together in nearly boiling water, with the addition of enough nitric acid to render the liquid strongly acid. The crystals deposited, on cooling, were in thick prisms, and when washed and pressed they left a very small residue; after two crystallisations of these, a crop of crystals was obtained, leaving only when dry ·016 per cent. of a reddish, slightly alkaline residue, and the mother liquor of the crop preceding these gave on evaporation crystals affording ·0159 per cent. of a similar residue, while from the mother liquors of both these crops evaporated together crystals were obtained in which I could not weigh the residue from about 30 grains. As M. Maumené's purest crystals contained ·09 per cent. of residue, it is evidently an excellent plan to render the original water strongly acid in purifying oxalic acid. I am, &c. Henry How.

University of King's College, Windsor, Nova Scotia, February 29.

Bankers' Cheque Paper.

To the Editor of the Chemical News.

Sir,—I see in your last number an allusion to the discussion which is now taking place in regard to the so-called anti-forgery paper for bankers' cheques.

I have been lately engaged in the examination of a few of these papers, and I think that some of your readers may perhaps feel interested in hearing the results of my observations.

The first cheques which were submitted to me were marked "Barclay's Patent Indelible, London," and proved on analysis to contain ferrocyanide of manganese. The paper was white, and was printed with an ink apparently owing its colour to carmine.

I immersed one of the cheques in a dilute solution of hypochlorite of calcium. The whole of the writing speedily disappeared, but a brown stain remained upon the paper. I then washed it, and treated it for a few seconds with dilute sulphurous acid, which restored the paper to its original whiteness. During this process the printed portions were, of course, removed, as well as the written ones; but this would have been the case equally if Mr. Barclay's process had not been applied to the paper. In another experiment I applied the same process to one of Mr. Barclay's cheques on which ordinary printing ink had been used. In this case no difficulty was experienced; the whole of the writing was removed, the printing was unaltered, and although the original green of the paper had acquired a bluer shade, yet it was found easy to restore the colour by tinting with yellow.

I subsequently found that, by the careful use of oxalic acid, it was possible to remove portions of writing even from the carmine-printed cheques without alteration in the colour of the paper, and with scarcely any injury to the printing.

I think it is evident from these facts that Mr. Barclay's process affords no security at all against the removal of writing from paper.

On reviewing the numerous patents which have been taken out at various times for the protection of bankers' cheques from fraud, one cannot help being struck with the want of originality which has characterised a good many of them. The following list of a few of these patents will illustrate this:—

1817.—Gabriel Tigere. Ferrocyanide of potassium incorporated with the pulp.

1837.—David Stevenson. Impure ferrocyanide of manganese in the pulp.

1858.—W. Herapath. Ferrocyanides, ferricyanides, and sulphocyanides, but preferably ferrocyanide of potassium.

1858.—Seyd and Brewer. Ferrocyanide of potassium. (Provisional protection only.)

1859.—Robert Barclay. Various processes are described, but the preference is given to the use of ferrocyanide of manganese.

It is impossible not to see the essential similarity in these five patents. Stevenson evidently intended the use of ferrocyanide of manganese, but he describes a bad process for obtaining it. Mr. Barclay avoids this difficulty by describing no process at all, and then claims a patent right for an original idea!—I am, &c.

Chas. W. Heaton.

Charing Cross Hospital, March 16.

[Dr. Letheby, we are informed, has completely discharged the writing on Barclay's patent paper, without affecting the colour of the paper, by the use of very dilute acid. —Ed. *C.N.*]

MISCELLANEOUS.

Royal Society.—The following gentlemen are proposed for election as members of the Royal Society:—Alexander Armstrong, M.D., William Baird, M.D., Sir Henry Barkly, K.C.B., Henry Foster Baxter, Sir Charles Tilstone Bright, William Brinton, M.D., John Charles Bucknill, M.D., Lieut.-Col. John Cameron, R.E., T. Spencer Cobbold, M.D., the Hon. James Cockle, M.A., Henry Dircks, Alexander John Ellis, John Evans, William Henry Flower, Sir Charles Fox, George Gore, George Robert Gray, Thomas Grubb, Henri Gueneau de Mussy, M.D., William Augustus Guy, M.B., George Harley, M.D., Sir John Charles Dalrymple Hay, Bart., Benjamin Hobson, M.D., William Charles Hood, M.D., Fleeming Jenkin, William Jenner, M.D., Edmund C. Johnson, M.D., Prof. Leone Levi, Walter Augustus Lewis, M.B., Sir Charles Locock, M.D., Edward Joseph Lowe, the Hon. Thomas M'Combie, Sir Joseph Olliffe, M.D., George Waring Ormerod, Thomas Lambe Phipson, John Russell Reynolds, M.D., William Henry Leighton Russell, B.A., William Sanders, Col. William James Smythe, R.A., Lieut.-Col. Alexander Strange, Thomas Tate, Charles Tomlinson, George Charles Wallich, M.D., Robert Warington, Charles Wye Williams, Nicholas Wood, Henry Worms.

Chemical Society.—The annual meeting of the Chemical Society will be held at Burlington House on the 30th inst. The following is the list of officers proposed for election:—*President*—A. W. Williamson, Ph.D., F.R.S. *Vice-Presidents, who have filled the Office of President*—W. T. Brande, F.R.S.; B. C. Brodie, F.R.S.; C. G. B. Daubeny, M.D., F.R.S.; Thomas Graham, F.R.S.; A. W. Hofmann, Ph.D., LL.D., F.R.S.; W. A. Miller, M.D., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Colonel Philip Yorke, F.R.S. *Vice-Presidents*—Walter Crum, F.R.S.; Alfred Smee, F.R.S.; John Stenhouse, LL.D., F.R.S.; Robert Warington. *Other Members of Council*—F. A. Abel, F.R.S.; Thomas Andrews, M.D., F.R.S.; Dugald Campbell; H. Debus, Ph.D., F.R.S.; J. B. Lawes, F.R.S.; A. Matthiessen, Ph.D., F.R.S.; Hugo Müller, Ph.D.; E. C. Nicholson; W. J. Russell, Ph.D.; Maxwell Simpson, M.B., F.R.S.; J. T. Way; C. Greville Williams, F.R.S. *Secretaries*—Theophilus Redwood, Ph.D.; William Odling, M.B., F.R.S. *Foreign Secretary*—E. Frankland, Ph.D., F.R.S. *Treasurer*—Warren De la Rue, Ph.D., F.R.S.

Society of Arts.—The following six lectures on "Chemistry applied to the Arts" will be delivered at the above Society, by Dr. F. Crace Calvert, F.R.S., on successive Thursday evenings, at 8 o'clock, commencing March 31:—

Lecture I.—*Bones.*—Composition of raw and boiled bones. The manufacture of superphosphate of lime. Application to agriculture. Bone-black or char, and their use in sugar refining. *Phosphorus*, its properties, extraction, and employment in manufacture of matches. *Horn* and *Ivory*, their composition and applications.

Lecture II.—*Gelatine, Glue, Bone-size, Chondrine*, their preparation, chemical properties, nutritive value, and application to arts and manufactures. Artificial tortoiseshell. *Isinglass*, its adulterations and adaptations to clarification of fluids. *Skins* and the art of tanning.

Lecture III.—*Leather.* — The art of the currier. Morocco, Russia, and patent leathers. The art of tanning skins. Chamois and glove skins. Parchment. *Hair*, its composition and dyeing. *Wool*, its washing, scouring, bleaching, and dyeing. *Silk*, its adulterations and conditioning.

Lecture IV.—*Animal Fatty Matters*, the various processes for liberating them from the tissues in which they are contained. Their composition and conversion into soap. Composite candles. The refining of lard. *Cod-liver, sperm*, and other oils. *Spermaceti* and *Wax*.

Lecture V.—*Flesh*, its chief constituents, boiling, roasting, and preservation. *Animal black*, its manufacture and applications. The employment of animal refuse in the manufacture of prussiate of potash. *Prussian blue.* Manufacture of artificial animal manures.

Lecture VI.—*Animal Liquids.*—*Bile*, its purification and detergent properties. *Blood*, its application in the refining of sugar and the manufacture of albumen. *Albumen*, its use in calico printing and photography. *Urine*, its uses. *Milk*, its composition, properties, falsification, and preservation. A few words on putrefaction.

A full report of the above lectures, corrected by the author, will be published in this Journal.

Silver Alum.—In a letter from Professor Church to the Editor, he announces that he has prepared a silver alum (the idea of the existence of such a compound being due to Mr. Northcote). Equivalent quantities of $Ag_2\cancel{S}\cancel{O}_4$ and $Al_43\cancel{S}\cancel{O}_4$ were heated together in a sealed tube in an oil-bath until the $Ag_2\cancel{S}\cancel{O}_4$ had completely dissolved in the small quantity of water present. On cooling, octohedrons were deposited. These were found on analysis to be—

$$Ag_2\cancel{S}\cancel{O}_4, Al_43\cancel{S}\cancel{O}_4 + 24H_2\cancel{O}$$
$$= 2(AgO, SO_3, Al_2O_3, 3SO_3 + 24HO).$$

They were resolved by water into their respective salts.

New Voltaic Pile.—M. Maistre Fils has proposed a new voltaic pile. The peculiarity consists in the employment of iron instead of zinc for the oxidable metal, and in the arrangement of the charcoal or copper discs; these, which are circular, are all placed on a spindle which can be made to revolve; the discs dip into the liquid in the cups to such an extent that about one-third of their surface is covered; the exciting liquid employed is water containing a hundredth part of its volume of nitric acid. Iron is considered better than zinc, because there is no danger of its forming a deposit on the discs, the revolution of which prevents their becoming coated with hydrogen, and so rendered inactive.

New Mode of Illumination.—M. Soubra, a Professor of Mathematics, has invented a new method of illumination, or rather a method of inverting a flame, by the adoption of which several advantages are expected to be realised. The apparatus consists of a syphon of glass, the open ends of which are turned upwards; a burner is placed just within the shorter branch. Before lighting the lamp, the longer branch of the syphon is heated, and a current of air established, which carries with it any flame placed at the open end of the shorter branch, the flame, consequently, becoming inverted. As soon as the current is established, and the burner kindled, the heating of the longer leg may be discontinued, the current, once established, being sustained by the heat from the inverted flame. The advantages of this new arrangement are as follows:—The supports of the globes or lamp-glasses are placed above the flame, and do not intercept the light; the reflectors, also, are in no danger of becoming blackened by smoke, and they collect rays that otherwise would be lost in the air. The flame has a more elevated temperature on account of the heat being concentrated by the syphon, and the carbon consequently more incandescent. The products of combustion are collected in the syphon, and may be conveyed away, instead of vitiating the air of the apartment. It is proposed to employ these reversed flames as footlights for theatres, the advantages, such as safety, &c., being obvious.

Condensation of a Solar Beam.—M. D. Van Monckhoven has communicated to the French Society of Photography a note "*On the Impossibility of Constructing an Optical Refracting System which will Augment the Intensity of the Solar Rays without Changing their Parallelism.*" He adverts to an arrangement of M. Bertsch, intended to effect this object, consisting of a convergent lens, which is placed so as to receive the solar rays perpendicularly, and, consequently, to form an image of the sun in its focus; a divergent lens is, however, interposed, and placed in such a position that the two foci coincide, and, therefore, rays converging to the common focus would, after passing through the second lens, emerge parallel and concentrated. M. Van Monckhoven demonstrates that although, in the case of a luminous point at an infinite distance, M. Bertsch's reasoning would be correct, it would be inapplicable to the sun's rays, because the sun has a sensible diameter, and since the image formed at its focus by the lens on which the light first fell would necessarily be larger than that which would be formed by the other at its focus, no condensation could possibly take place; M. Monckhoven applies his argument to a slightly different arrangement to that of M. Bertsch, the difference consisting in the employment of a small convex lens placed beyond the focus, instead of a concave one intercepted between the large lens and its focus. To this attack M. Bertsch replies that he has successfully applied this arrangement to photographic purposes, and that the angles of the pencils of rays proceeding from the sun, never exceeding half a degree, are so small that they may be neglected.

Employment of the Electric Light for Scenic Effects.—The electric light appears to have permanently taken its place amongst theatrical properties. In Paris where more attention is paid to scientific effects than in this country, the celebrated optician, Duboscq, has devised some marvellous imitations of lightning and of the rainbow. The former is obtained by a concave mirror, in the focus of which are the two carbon poles of a powerful battery nearly in contact, and so adjusted that when the mirror is rapidly moved in the hand, the poles touch for a brief interval, and flash a dazzling beam of light across the stage. The zig-zag effect of lightning, and its peculiar blue colour, are very perfectly imitated by this means. But more wonderful than this is the rainbow. In the representation of the opera of *Moïse*, it is requisite, in the first act, to introduce a rainbow; and this has hitherto been effected either by painting, or by projecting the image on the scene from a magic-lantern with a coloured slide. In the latter case the stage had to be darkened in order to allow the rainbow to be seen; and this, of course, destroyed the illusion. M. Duboscq, by a happy modification of his spectrum apparatus, and by employing a curved, instead of a straight, slit, and a small-angled prism, has succeeded in projecting the very brilliant electric spectrum on the scene, with the proper curvature and the identical colours of the real rainbow; and this is of such a vividness that it is plainly visible in the full light of the stage. In these days of sensation-spectacles we feel confident that a real rainbow on the stage would attract quite as crowded houses as a "tremendous header," and we are surprised that no manager has introduced so novel an effect this Christmas. —*Chronicle of Optics, Quarterly Journal of Science*, No. 2.

On the Retardation of the Earth's Rotation.—In a contemporary Mr. Garbett takes exception to the concluding paragraph of Dr. Frankland's recent discourse on the Glacial Epoch (Chemical News, vol. ix., p. 116), and contends that the friction of the tides can never do more than reduce the earth's axial rotation to a monthly one. Dr. Frankland thus writes in reply:—"Mr. Garbett has very graphically and truly described the operation of the tides in retarding the earth's diurnal rotation to be, 'in effect, the same as if the earth rubbed slightly against her satellite.' We are thus in accord respecting the result of the tidal friction, so far as a retardation to a monthly rotation is concerned, and we may therefore take this as our point of departure. Arrived at this stage, the earth would constantly turn the same hemisphere towards the moon, and, as a necessary consequence, the oceanic tide due to the moon's attraction would become stationary in longitude, although it would undergo a monthly oscillation in latitude, due to the inclination of the moon's orbit to the plane of the earth's equator,—the accumulation of the oceanic waters occurring in the line of the centres of the earth and moon. Thus the friction of the lunar tide in longitude would entirely cease, whilst that in latitude would have no effect upon the earth's axial rotation. At this point Mr. Garbett asserts that the maximum retardation would be attained; but, in arriving at this conclusion, he overlooks the fact that a monthly solar tide equal to two-fifths of the lunar one would still exist and exert a retarding influence upon the now monthly rotation of the earth. In other words, and in accordance with his own simile, the earth not only rubs against the moon, but also against the sun. Now, as soon as this further retardation commenced, it would of course again set in motion a lunar tide, which, acting in an opposite direction, would tend to neutralise the effect of the solar tide. But the friction of these two tides would clearly be dependent upon the velocity of each wave as well as upon its height, and it is evident that, although the altitude of the lunar wave would be more than twice that of the solar one, yet its velocity would, for a long time, be much smaller. Consequently, the friction of the solar wave would be greatly in excess of that caused by the lunar one, and the retardation would therefore still proceed until the friction of the two tidal waves became exactly equal. At what period such equality would be attained I am not prepared to say, but it would obviously be produced by some rate of axial rotation between a monthly and an annual one. Thus there can be no doubt that, under the conditions contemplated, the retardation would not stop at a monthly revolution, as stated by Mr. Garbett, but would go on until a considerably slower rate was arrived at. I am also of opinion that other circumstances would prevent the friction of the solar tide from being perfectly neutralised until an annual axial rotation of the earth was established; but, as I am not at present prepared to state the arguments upon which this opinion is based, I do not now insist upon it. Mr. Garbett further objects to my assuming that the terrestrial ocean would not be engulphed before it had effected by its friction the contemplated retardation of the earth's axial motion. In a case like this, where two catastrophes are approaching at an inconceivably slow and altogether unknown rate, it is obviously impossible to calculate with certainty the prior advent of either; but, in accordance with the supposition upon which I was speaking at the close of my lecture—viz., that the moon had encountered these catastrophes in the order indicated —I can see no *à priori* reason why they should not occur to the earth in the same order. In conclusion, I beg to say that the latter portion of my discourse was of a purely suggestive and speculative character, and was by no means intended as a formal exposition of the cosmical events mentioned therein."

The Abbé Moigno's translation of Professor Tyndall's "Heat as a Mode of Motion" is announced in Paris.

M. Maumene has written a memoir entitled "Theorie Générale de l'Exercice de l'Affinité." By the help of this theory he is enabled to calculate *a priori* the results of the action of sulphuric acid upon metals and metalloids; also to determine the conditions of the formation of ammonia from nitric acid, &c., to explain the phenomena of the precipitation of metals by one another from their saline solutions, to analyse a great number of the phenomena of organic chemistry, and, in fact, to calculate all the results of the chemical action between a solid and a liquid, or between two liquids incapable of mixture. If this theory be really correct, a great step will have been made, and chemistry will rapidly become a mathematical science.

A Dispute has been for some time carried on in the *Journal für Gasbeleuchtung* between Professor Mulder, of Utrecht, and several other chemists, as to the danger of using, in the manufacture of gas, coals which have been injured by sea water. Some time back, it appears, a purifier at the Utrecht gas works exploded, and Professor Mulder accounted for it by suggesting that the pipes had become stopped by chloride of calcium, which, he supposed, had been formed owing to the presence of salt in the coal. He says that when coals have absorbed such a quantity of sea water that 10,000 lbs. of coal contain 7 lbs. of salt, the chlorine combines with the lime and forms chloride of calcium. The professor alleges such to have been the cause of the accident in question, but this view is opposed by several chemists practically acquainted with the subject.

ANSWERS TO CORRESPONDENTS.

J. Bungate will receive an answer by post.

Dr. Attfield's letter shall appear in our next.

C. S.—Aniline will dissolve fats and oils to any extent.

J. A.—You will find a very good account in Nichol's "Cyclopœdia of the Physical Sciences."

A Subscriber.—We are not certain that the patent has yet been published, but we shall shortly give an account of some experiments with the process.

Enquirer.—Graham's paper will be found in the *Philosophical Transactions* for 1862; but you will find an account of dialysis in many books. Dr. Odling's lecture in Vol. V. of the Chemical News is an excellent account.

Book Received.—"Percy's Metallurgy—Iron and Steel."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Atomicity of Oxygen, Sulphur, Selenium, and Tellurium, by M.* NAQUET.

On the Atomicity of Elements, by M.* KEKULÉ.

M. NAQUET starts with the question—Have simple bodies and compound radicals an invariable atomicity, or have they at the same time several atomicities?

The question, he says, appears to be one of words rather than facts. If by atomicity we understand merely the substitutional value of a body, without taking into account the degree of saturation of the compounds formed, then it is certain that bodies have several atomicities; but if we regard the atomicity of a body as its maximum capacity for saturation, then it is no less certain that the atomicity of a body is invariable.

Until now it has been admitted that sulphur, selenium, and tellurium have an atomicity equal to two, and it is a fact that, in the largest number of their compounds, they are substituted for, or combined with, two atoms of hydrogen or some other monatomic radical; but there are bodies into which sulphur, selenium, and tellurium enter with a substitutional value equal to four. We must say, then, that these bodies are either bi- or tetra-atomic, or tetra-atomic only, just as we accept one or the other definitions of atomicity given above,

The researches of M. Carius have shown that there probably exists a chloride of sulphur, having the formula S̶Cl_4, ($\text{S̶} = 32$. $\text{S̶e} = 79{\cdot}5$. $Te = 129$,) and we have long known a chloride of selenium and a chloride of tellurium which, by the action of water, are transformed into selenious and tellurous acids without the deposition of either of the metalloids. These are definite compounds, answering to the formulæ S̶eCl_4 and $Te\text{Cl}_4$. Further, tellurium forms similar compounds with bromine, iodine, and fluorine. The last has never been analysed, and its composition is only inferred from analogy.

M. Naquet, therefore, regards the tetra-atomicity of sulphur, selenium, and tellurium as *established*, and goes on to give reasons for believing oxygen also to be tetra-atomic.

M. Kekulé thinks it his duty to reply to M. Naquet, since he believes that he first introduced into chemistry the idea of the atomicity of elements. He therefore explains as concisely as possible some of the fundamental ideas of the theory. We have known a long time, he says, that elementary bodies combine according to the law of constant proportions and the law of multiple proportions. The first of these laws is perfectly explained in the atomic theory of Dalton; the same theory only explains the second law in a general and vague way. What Dalton's theory does not explain is, why the atoms of different elements combine in certain proportions rather than in others. I have endeavoured to explain the whole of the facts by what I have called the *atomicity of elements.*

The theory of atomicity is therefore a modification of the atomic theory of Dalton, and according to my idea, atomicity is a fundamental property of the element, a property which must be constant and invariable, like the weight of the atom itself. To allow that the atomicity may vary, and that one and the same element may act sometimes with one atomicity and sometimes with another, is to apply the word in a sense quite different from that I intended when I proposed it; it is to confound the idea of atomicity with that of equivalence. Nobody now doubts that one and the same body, even elementary, is capable of acting with different equivalents. The equivalent may vary, but not the atomicity. The variation of the equivalent must, on the contrary, be explained by the atomicity.

A second confusion has arisen from the definition which it has been attempted to give to atomicity. Instead of choosing among the different possible senses, that which explains it in the simplest and most complete manner, atomicity has been defined as *the maximum equivalent* or the *maximum capacity for saturation.* If this definition be admitted it follows that we must consider as pentatomic, elements which I have regarded as triatomic, such as N, P, Sb, As, Bi. The same idea has led M. Naquet to regard as tetra-atomic the elements Θ, S̶, S̶e, Te, which we have hitherto looked on as bi-atomic. It must also lead us to suppose iodine triatomic, as well as other bodies, chlorine and bromine, which we now take for monatomic.

In fact, if the existence of the compounds NH_4Cl and PCl_5 demonstrates that nitrogen and phosphorus are pentatomic; if the substances quoted by M. Naquet (S̶Cl_4 &c.” establish that sulphur, selenium, and tellurium are tetra-atomic, we must conclude that the existence of the compound ICl_3 proves that iodine is triatomic.

Such reasoning need not be met with arguments; it reduces itself to absurdity. In effect, the triatomicity of iodine being in this way *established*, it is only necessary to look at the compounds PI_3 and TeI_4 to be convinced that phosphorus is nonatomic, and that the atomicity of tellurium is equal to 12. Further than this, chlorine having evidently the same atomicity as iodine, *i.e*, triatomic, the existence of the compound ICl_3 proves that iodine is no longer triatomic, but nonatomic and so on.

M. Kekulé then goes on to give a succinct *resumé* of his ideas on the subject of atomicity; but for this we have not space this week.

TECHNICAL CHEMISTRY.

The Chemical Constitution of Pig-Iron.†

HERR RAMMELSBERG has recently investigated the views of Karsten and Gurlt on the chemical constitution of pig-iron (*see* Erdmann's *Jour. f. pr. Chem*, Bd. 89, S. 393) and has arrived at essentially different conclusions. According to Karsten, white and grey iron are chemical combinations of carbon with iron—the grey iron containing, at the same time, an admixture of graphite. This remains unchanged on the iron being dissolved in acids; while the chemically combined carbon—particularly with concentrated acids—is changed into a strongly odoriferous oil-like combination, the greater part of which volatilises in the hydrogen, only a small portion dissolving in the acid. According to their views, Spiegeleisen is a chemical combination of iron with the maximum amount of carbon, 5 to 6 per cent., but containing no graphite.

Rammelsberg, on the contrary, has found 1·61 per cent. of graphite in the Müsen Spiegeleisen; and Bromeis, before him, found graphite in the white pig-

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* Abridged from *Comptes-Rendus*, t. lviii., pp. 381, 510.

† *Poggendorff's Annalen*, Bd. 120, S. 51.

iron of Mägdesprung, as will be seen by the following analysis:—

	Carbon in Combination. Per cent.	Graphite. Per cent.	Total. Per cent.
Bright white pig-iron .	2·518	0·500	3·018
Grey pig-iron . .	2·908	0·550	3·458
Spiegeleisen . .	3·100	0·72	3·820

As, according to Rammelsberg, the Mägdesprung Spiegeleisen only contains 3·9 per cent. of carbon, it seems that this class of iron may contain very unequal quantities of carbon, as well as an admixture of graphite, without any change in its character or properties. It might have been supposed that other metalloids replaced carbon—for example, silicon; but the analyses show, on the contrary, that the iron richest in carbon was also richest in silicon. In the Müsen Spiegeleisen there was found 1·5 per cent. of silicon, in that of Mägdesprung 0·17, and in that of Styria from 0·01 to 0·27 per cent.—the latter only containing from 3·75 to 4·14 per cent. of carbon.

According to Gurlt, Spiegeleisen is a fourth carbide, and octahedric crystalline grey pig-iron an eighth carbide; the phosphorus, sulphur, and silicon being isomorphous with the carbon, and the manganese with the iron. But if in stating the atomic ratio between the electro-positive and the electro-negative constituents of the Spiegeleisen of Müsen and Mägdesprung we adopt Rammelsberg's view, we have a ratio of 1 : 4·5 and 1 : 5·3 instead of 1 : 4. The grey octahedric crystals (the eighth carbide of Gurlt, approximating to wrought iron according to Tunner) are found to be very variable in composition, as shown by the following analysis :—

	From Rothehütte. By Rammelsberg.	From Lauchhammer. By Rammelsberg.	From Gleiwitz. By Gurlt.	From Lölling. By Richter.
Graphite .	2·604	2·519	2·84	2·122
Carbon . .	0·201	0·373	2·46	0·967
Silicon . .	1·896	1·148	0·26	0·972
Phosphorus .	0·065	0·406	?	0·021
Sulphur . .	0·069	0·043	?	0·008
Arsenic . .	—	—	—	0·005
Atomic ratio .	1 : 19	1 : 21	1 : 8	12·5

Therefore, there are generally more than eight atoms of iron to one atom of carbon (silicon, phosphorus).

It will thus be seen that white as well as grey pig-iron may crystallise under favourable circumstances, without the formation of the crystals being disturbed by the embedded graphite. The variation in the composition of the crystals, shown by the above analyses—taking place without any alteration in the crystalline form—can only be accounted for by the isomorphism of the elements; and according to Rammelsberg, such is the only possible explanation of the constitution of pig-iron. As all the essential constituents of pig-iron—such as iron, silicon, phosphorus, and carbon (as diamond)—crystallise on the regular system, and are consequently all isomorphous, we may consider pig-iron as an isomorphous mixture of its constituents, which will explain the variation of its composition.

There are many examples of metals belonging to the regular system which form alloys that again crystallise on the same system; but there are also many alloys which crystallise on this system, whose constituent metals belong to distinct crystalline systems. On the other hand, metals that crystallise on the regular system form alloys crystallising on a different system; thus, for example, silver, zinc, nickel, and copper (iron), alloyed with antimony, crystallise on the pyramidal system. If, therefore, Spiegeleisen is pyramidal, as is probably the case, it belongs to this class of isomorphous mixtures; and the difference of form in grey and white pig-iron results from the heteromorphism of their isomorphous constituents. This heteromorphism is evidently a general characteristic of the elements, being just as marked in the metals as in sulphur and carbon. Doubtless the rhombohedric metals—Sb, As, Fe, Bi, Zn, Pd, Ir, and Rd—and the tetragonal Sn, isomorphous to Bo, may, under certain circumstances, crystallise on the regular system; while Au, Ag, Cu, Pb, &c., and also Sn, may be rhombohedric.—*Mining Journal.*

PHYSICAL SCIENCE.

On the Indices of Refraction of Frauenhofer's Lines, by M. Van der Willigen.

The following extract from the *Comptes Rendus de l'Academie*, des Pays-Bas, gives the indices of refraction of twelve rays of the solar spectrum for distilled water. $\overline{G}$ and $\overline{H}$ are two intermediate rays between F and G and G and H, which I have added to those already marked—that is to say, to ten of Fraunhofer. $\overline{G}$ indicates that this ray is situated above G; I do not think it desirable to introduce new letters for these rays on account of the confusion which might result.

The columns I and II differ the one from the other by the inversion of the lateral plates which closed the prism, so as to eliminate the defects of parallelism of the surface of these glasses.

These glasses were prisms of an angle of two to three minutes, which I measured.

I have introduced the necessary corrections, and the combination of columns I. and II. in the third ought to do away with the small faults which may still remain.

The instrument I used is a spectrometre of Meyerstein, of Göettingue, which, with the aid of microscopes, gives the angles to a second.

The fifth column gives Fraunhofer's numbers.

The sixth column shows that these numbers are rather higher than mine, which seems to indicate that the water Fraunhofer used was neither distilled nor sufficiently pure.

This increasing difference between Fraunhofer and myself does not disturb me, for the same impurity which produces our general difference may also produce increasing difference in the dispersion more than adequate to account for this successive augmentation of differences.

The variation by degrees of temperature, shown at the bottom of the table, is deducted from the total variation for 9°·8 taken from the two positions I. and II., for each of these columns is the mean of two others obtained at different temperatures; and the differences between the two fundamental series of each column combined gave the value 6·03. On multiplying it by 5·8, 35 is obtained, which shows that the mean difference between the columns I. and II. may be explained by the difference of temperature, and indicates the preciseness of the corrections applied to these columns; that is to say, for the exactness of the values given to the angles of the prisms formed by the glasses, which ought to have parallel faces.

The water was not freed from air, for it seems to me impossible that it could have remained pure during these observations.

I hope soon to complete a more extended memoir on the indices of the refraction of water and of mixtures of water and sulphuric acid, of which this extract is but the preamble :—

	Temperature. 22°·37 C. I.	Temperature. 16°·58 C. II.	Temperature. 19° 5 C. Mean.	Temperature.	18°·750 Fraunhofer.	Difference.
A.	1·32876	1·32921	1·32899	19·4	—	—
a.	1·32966	1·33000	1·32883	19·4	—	—
B.	1·33031	1·33064	1·33048	19·4	1.330956	48
C.	1·33101	1·33142	1.33122	19·5	1·331710	49
D.	1·33282	1·33332	1·33307	19·5	1 333577	51
E.	1·33502	1·33553	1·33527	19·5	1·335850	58
b.	1·33541	1·33589	1·38565	19·5	—	—
F.	1·33698	1·33741	1·33720	19·5	1·337803	60
$\overline{\text{G}}$.	1·33880	1·33923	1·33901	20·0	—	—
G.	1·34049	1·34077	1·34063	19·5	1·341277	65
$\overline{\text{H}}$.	1·34223	1·34245	1·34234	19·5	—	—
H.	1·34338	1·34561	1·34350	19·5	1·544170	67

Variation for one degree of temperature = 6·03. Difference of temperature I. and II. = 5°·8. 5·8 × 6·03 = 35. —*Les Mondes*, 395, 63.

PHOTOGRAPHY.

On Celestial Photography in America, by Professor Henry Draper, *M.D., New York University.*

The first photographs of the moon were taken in 1840 by my father, Professor John W. Draper, M.D., who published notices of them in his quarto work, "On the Forces that Organise Plants," and in the *Philosophical Magazine.* The specimens were about an inch in diameter, and were presented to the Lyceum of Natural History of New York. They were made by means of a lens of five inches aperture, furnished with an eye-piece to increase the magnifying power, and mounted on a polar axis driven by a clock. At that time it was generally supposed that the moon's light contained no actinic rays, and was entirely without effect on the sensitive silver compounds used in daguerreotyping.

In 1850 Mr. Bond made use of the Cambridge (Massachusetts) refractor of fifteen inches' aperture, to produce daguerreotype impressions of our satellite, the sensitive plate being placed at the focus of the object-glass, without the intervention of an eye-piece. Pictures two inches in diameter were thus produced, and subsequently some of the same size were made on glass, and mounted stereoscopically. Mr. Bond also made a series of experiments to determine whether photography could be advantageously applied to the measurement of double stars, and concluded that the results were as reliable as those derived from the micrometer.*

Soon after, Mr. Warren De La Rue, of Cranford, near London, undertook, by the aid of a thirteen-inch speculum, ground and polished by himself, to produce a series of photographs of the moon and other celestial objects. The excellent results that he has obtained, together with those of Professor Phillips, Mr. Hartnup, Mr. Crookes, Father Secchi, and other physicists, are doubtless familiar to all scientific men, having been published in the form of a report to the British Association in 1859. No detailed description of them is necessary, therefore, in this place.

In 1857 Mr. Lewis M. Rutherfurd, of New York, erected an equatorial refractor of eleven inches' aperture, the object glass of which he had himself corrected, and has taken a large number of lunar photographs with it. They have generally borne to be magnified to five inches, and he is now engaged in perfecting a correcting lens that will allow still greater enlargement to be used.

The moon, as seen by the naked eye, is about one-tenth of an inch in diameter, although persons generally estimate it at ten inches. That the first statement is true is easily proved either by taking a photograph with a lens of ten inches' focal length, or more convincingly by holding up between the moon and the eye a little disc one-tenth of an inch across, at the nearest distance of distinct vision (ten inches). A picture of the moon of the size commonly attributed to her requires to be made under a power of 100 times.

In 1859 I visited Lord Rosse's great reflecting telescopes at Parsonstown, and had an opportunity of not only seeing the grinding and polishing operation by which they were produced, but also of observing some stars through the six-foot instrument. On returning home in 1858 it was determined to construct a large instrument by similar means, and devote it especially to celestial photography. The speculum was of fifteen inches' aperture, and twelve feet focal length. Subsequently, however, this metal mirror was abandoned, and silvered glass, as suggested by M. Foucault, substituted. This latter, according to Steinheil's experiments, reflects more than 90 per cent. of the light falling upon it, while speculum metal only returns 63 per cent. A detailed account of this instrument, amply illustrated, is now being published by the Smithsonian Institution at Washington, and therefore only a general idea of its peculiarities will be given.

As the telescope was intended especially for photography, the following general principles were adopted:—1st. A reflector was, of course, preferred to an achromatic object glass, because all the rays falling upon it are reflected to the same focal plane, and there is not, as in the latter, one focus for distinct vision and another for the photographically actinic rays, an inch distant perhaps. In the reflector, a sensitive plate put where the image is seen to be most sharply defined will be sure to give a good result. In the achromatic, on the contrary, the sensitive plate must be placed in a position which can only be found by tedious trials. 2nd. Silvered glass was used instead of speculum metal because it is lighter and more highly reflecting. Besides, if a reddish or yellowish film should accumulate on it—an accident liable to occur to either kind of reflector, and seriously diminishing the photographic power—it can either be repolished with a piece of buckskin—an operation obviously impossible in the case of a speculum metal—or the silver can be dissolved off with nitric acid, and a new film deposited on the glass concave. The glass, which has been made accurately parabolic before the first silvering, is not changed in figure, the silver being only deposited in a layer $\frac{1}{200000}$th of an inch thick, and consequently, if carefully prepared, copying the glass below so closely that no error larger than a small fraction of that amount is possible. As the glass only serves as a basis or mould for the thin sheet of silver, and is not penetrated by the light, its quality is a matter of but little moment, that which is used for skylights or light-openings in floors answering perfectly. 3rd. A mounting presenting the greatest degree of steadiness possible was necessary. For this purpose the telescope was supported at both ends, the lower one resting in a loop of wire rope. 4th. Instead of driving the whole mass of the instrument by clockwork acting upon a polar axis, and thus being forced to move a weight of at least half-a-ton—the usual system in equatorials—only the sensitive plate and its frame, weighing an ounce, were caused to follow the moon or other object, the mass of the apparatus remaining perfectly at rest. This idea is due to Lord Rosse. 5th. Instead of using a clock with whee

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* "Astron. Nach," No. 1129.

work for a prime mover, a *clepsydra* was substituted. This consists of a heavy weight supported by the rod of a piston, which fits into a cylinder filled with water. At the bottom of the cylinder a stopcock permits the water to flow out at a variable speed, depending on the amount of opening. The sensitive plate can thus easily be caused to coincide in rate with the moving object, and yet by a motion free from irregularity and tremor.

The value of a silver reflector turns, of course, entirely upon the perfection of the glass concave on which the metallic film is to be deposited. This must be of a parabolic figure, so that spherical aberration may be completely corrected. A person is, however, content to take the utmost pains to produce it, because, once attained, the figure cannot be lost except by fracture, and the value does not diminish with time, as in the case of a speculum. It never requires re-polishing. The best method of grinding and polishing the glass is by means of an apparatus that I have called a "Local-correcting Machine," by which all the parts of the surface can be attacked in succession and reduced to the desired curvature, and yet at the same time a uniform curve and absence of local irregularities secured. I have spent five years in the investigation of this subject, and have polished more than 100 mirrors of from nineteen inches to one-fourth of an inch in diameter on seven different machines built at various times. The quality of those I have at present is indicated by the fact that they will show *Debillisima* to be quintuple, and will render the close companion of Sirius, discovered by Alvan Clark's magnificent eighteen and a-half inch refractor, visible.

The Observatory at Hastings-upon-Hudson, near New York, lat. 40° 59′ 25″ N., long. 73° 52′ 25″ W. of Greenwich, is upon the summit of a hill 225 feet above low-water mark. It is twenty feet square, with a wing 9 × 10 for a photographic laboratory. As the telescope is a Newtonian, with the mounting so contrived as to have the eyepiece stationary at all altitudes, a plan originally suggested by Miss Herschel, there are peculiar facilities offered for easy access to the eyepiece, or place of the sensitive plate. The interior height of the Observatory, twenty-two feet, is divided into two stories, around the upper of which an observer's chair runs to follow the telescope. The dome turns upon a pivot at its centre, instead of on rollers or cannon-balls around the edge, and is moved consequently with but slight exertion.

Since the telescope has been completed, and furnished with two parabolic mirrors of fifteen and a-half inches' aperture, and 150 inches' focal length, and one Herschelian mirror (that is, a concave of such figure that it can only bring oblique pencils to a focus free from aberration), celestial photography has been continually prosecuted. About 1500 lunar negatives have been taken. Old experience obtained from portrait and microscopic photography has proved to be of great service. At first the well-known processes were used, but it was soon found that something more refined was needed, where the pictures are to be submitted to magnifying powers of perhaps twenty-five times. Defects in collodion negatives that would, under ordinary circumstances, pass unnoticed, assume such prominence as greatly to diminish the beauty of the results. These defects, pin-holes, coarse granular appearance of the reduced silver, and other markings were found to arise principally from the presence of nitrate of silver on the sensitive plate. It was ascertained that by washing the plate thoroughly before exposure they disappeared, or were very much ameliorated, and without any reduction in sensitiveness. But for this washing operation pure water is needed, and hence the roof of the buildings was painted with a ground mineral compound that hardens to a stony consistence, and the water falling upon it was preserved in a leaden tank, which, from long use for other purposes, had become thickly coated with insoluble salts of lead, sulphates, &c. Whenever an inch of rain falls, a ton of water is collected, and the tank may be filled about thirty-two times in a year.

The negatives produced at the focus of the reflector are on an average $1\frac{4}{10}$ inches in diameter. Many that have been made will bear to be enlarged to two feet, and one was taken September 3, 1863, at 4.30 a.m., which has been increased to three feet in diameter, the total magnifying power used being about 380. In this photograph the moon may be said to be shown on a scale of sixty miles to the inch.

In the process of enlarging I have introduced one very important novelty. Instead of employing an achromatic combination of lenses arranged as a solar camera, a concave mirror is used. It entirely gets rid of the difficulty of chromatic aberration, which is, as all photographers know, one of the most serious obstacles to success, and, in addition, the magnified image lies in one plane, or there is what is termed a flat field. Every little detail of the original negative is perfectly reproduced, and a three-foot image is as sharp in one part as in another. The effect of portraits reproduced of life-size is very striking, and the resemblance to the individual singularly increased. In magnifying these lunar negatives, a mirror of eight inches' aperture and eleven and a-half inches' focal length is used. At first, when it was intended to employ diffused daylight and the whole aperture, the figure was made elliptical, with a distance of eight feet between the conjugate foci; but subsequently, when the advantages of sunlight were understood, the surface was reduced by a diaphragm to a little more than an inch in diameter, and a part of the mirror as nearly perfect as a mirror can be made at present was selected. Success in enlargement becomes with this contrivance a certainty.

The "enlarger" is also equally valuable in copying by contact. When a small negative is enlarged and photographed, what is termed a positive results. If such a positive is used to make prints on paper, the lights and shades are inverted, and that which is white is shown black. It is necessary then to turn the original negative into a positive, so that when magnified a negative may result suitable for printing positive proofs on paper. This is done usually by a process called reversing, in which a sensitive plate is placed behind the original negative, and the two exposed to the light. Wherever the negative is transparent the plate behind is stained by the light, and where opaque it is protected. But unless the plate behind is so close as to make the chances of scratching the negative very great, the positive produced is much inferior in distinctness, because the diffused light of day finds its way through in many directions. If, however, the negative and sensitive plate are placed in the beam of sunlight coming from the enlarger, the rays pass through only in one direction, and the reverse or positive is as sharp as the original negative.

Celestial photography is as yet only in its infancy. The results to which it has given origin, although excellent in many respects, have imperfections. But it seems probable that these may be overcome in the future, partly by means now within reach, and partly by others which may be discovered at any moment. In looking at a three-foot photograph from such a distance that the eye can embrace it all at one glance, the general effect is certainly very fine, and superior to observation through the telescope with a similar power. The moon appears as it would if viewed from a stand-point 600 miles from its surface. Ranges of mountains, as the Apennines, seem as if projected out from the general level, while the great craters, such as Plato, Theophilus, and Clavius, are deeply excavated below. Grooves of vast extent, like those diverging from Tycho, and faults such as that running past Kant and Catharina on the one side, and Tacitus on the other towards Lindenau, still further break up the surface. The well-known seas and bright portions, so distinct to the naked eye, are lost in the multiplicity of the details into which they are resolved.

But coming more closely to the picture, and examining with a critical eye, it is apparent that, although the general effect is the same as would be perceived by looking at the moon itself, yet some of the minute details seen in the telescope with a high power are absent.

The reasons which lie at the bottom of this difficulty are connected to a certain degree with the photographic processes employed, but also to not a little extent with the condition of the air. The quality of the instrumental means used is, of course, of primary importance. A good photograph cannot be taken with an inferior telescope and clock.

The obstacles arising from photography result from the fact that the dark parts of the picture are not formed by a continuous sheet of material, but by an aggregation of granules which, though invisible to the unassisted eye, are seen when a high-enough magnifying power is employed. Their degree of visibility turns on the system of development used for bringing out the latent image on the sensitive plate. A picture injudiciously forced with pyrogallic acid will hardly bear any enlargement, though one made with sulphate of iron and a well-regulated exposure may be increased in diameter twenty-five times, without showing the granulations offensively. The influence of the structure of the collodion-film itself, too, is noticeable in pictures taken by the wet process; in the first place, being somewhat transparent, it permits a certain amount of lateral diffusion in the film, and a tendency to soften down the more minute details; and, in the second place, while wet it has quite a perceptible thickness, which is much diminished in drying, and the relation of the silver particles to one another changed.

I have attempted to avoid the faults connected with structure of the film by substituting dry collodion, and more particularly tannin plates for the wet. But though during the exposure to the celestial object the sensitive plate presents a glassy surface of extreme thinness, yet an indispensable preliminary to evoking the latent image is to soak the plate in water, and this introduces the more injurious of the two objections above urged. It was while trying this process that I ascertained the advantages that arise from warming the film during development,—the "hot-water process," as it is called. The attempt was also made to daguerreotype the original pictures at the focus of the telescope on silver plating, and also on silvered glass. In this case all lateral diffusion is entirely prevented, the light acting on a mathematical surface, and the relations of the film of silver to the glass not being disturbed by the subsequent manœuvres. But practically no advantage has arisen from these trials, because, as in the former instance, the whites in the resulting picture are not formed by a continuous stratum of mercurial amalgam. That this is the case is proved by the fact that such daguerreotypes can be copied by the electrotype, or a coating of isinglass, as was shown by Dr. Draper (*Philosophical Magazine*, May 1843). This is the first occasion on which silvered glass has been used for photographic purposes, and it may be well to point out its advantages. Owing probably to the perfect purity of the silver, it takes the coatings of iodine and bromine with uniformity all over; in silver plated by fire on copper, there used to be a tendency to insensitive spots, from the copper alloy coming out on the face of the silver, and so great was the annoyance, that, when my father was engaged in the experiments that led him to take the first portrait ever obtained from life, he was compelled to use sheets of pure silver alone. The light also seems to be able to impress the iodo-bromide in less time, and pictures of a rosy warmth are generally obtained. The only precaution necessary in practising this method of daguerreotyping is to fix the plate—that is, dissolve off the excess of sensitive material—with an alcoholic solution of cyanide of potassium, instead of an aqueous solution of hyposulphite of soda. The latter tends to split up the film of silver from the glass here and there, while the former does not. The subsequent washing, too, is most safely conducted with diluted common alcohol. The time of exposure is not, however, as short as in the wet collodion process, at least six times the exposure being demanded; while if less is given, and the development over mercurial vapour be urged beyond the usual point, minute globules of mercury stud the silver all over, and ruin the proof.

The faults arising from atmospheric disturbances are easily understood. If an image of the planet Jupiter produced by a large telescope be allowed to move across a sensitive plate, and the plate be then developed, a dark streak nearly of the width of the image will appear. If this streak is closely examined, it will be observed that the passage of the planet seems to have taken place in an irregular way—by fits and starts as it were, and that instead of the mark being continuous like that of a pencil, it rather resembles a string of beads. The cause of this lack of continuity is to be found in the movements of the earth's atmosphere. Or, if the eye is placed at the eyepiece of the telescope, and the edge of a planet or the moon watched, it is found to present a wavy outline instead of a sharp disc-like appearance. Any point in the surface, too, is seen to have a rapid vibratory motion.

Although the eye can emancipate itself to a certain extent from these disturbances, a photographic plate cannot. Every point tends then to assume a greater size and less distinctness than it should have, and if the night on which the trials are being made is very unsteady, the smaller details are so confused together that the picture is worthless. Occasionally, however, very still nights occur, when photographs of great beauty may be taken. In the interval between March and December, 1863, three such nights occurred, and on one of them the negative for the three-foot was obtained.

It has been stated that there are no insuperable obstacles to the production of perfect celestial photographs,—that is, such as realise the full optical power of the telescope used. The atmospheric difficulty may be successfully combated by removing a large reflector from near the level of the sea to a considerable altitude, where a great part of the atmosphere is left behind. It seems to me that a suitable place for such a purpose would be the rainless west coast of South America, somewhere near the equator. Improvements, too, are continually being invented in photographic processes, and a considerable step is made when we find out what it is that we need. Quick methods are not so much required as those which will yield grainless pictures on structureless films, and unless the time of exposure could be so much shortened as to be but a small fraction of a single atmospheric pulsation, no particular advantage would be gained by their use.

The inducements to amateurs to prosecute the study of celestial photography are very great, and the apparatus required is such as any one of a mechanical turn may make. A great deal can and will be done in this branch of astronomy; and animated by the hope that many others may be induced to cultivate it, I have written the detailed account in the Smithsonian Contributions.—From the *Quarterly Journal of Science*, No. 2, April, 1864.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

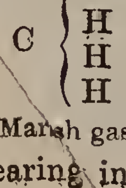
Thursday, March 17, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The business of the evening commenced as usual by the reading of the minute book; after which Dr. Thomas Stevenson and Mr. Williams were formally admitted by the President, and the Society proceeded to ballot for Mr. Thomas L. G. Bell, of Victoria Docks, and Mr. Benjamin Charles Staples, of London, both of whom were duly elected Fellows of the Society.

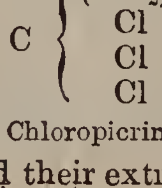
The President then said he regretted to have to announce that the Society would not be favoured that evening with the presence of Sir Benjamin Brodie, who had promised to address them on a theoretical subject of great interest. He was informed a day or two since that Professor Brodie had met with an accident during the preparation of some peroxide of acetyl which he required for the purpose of illustrating his lecture. A glass apparatus containing the material exploded in his hand, and the fragments had cut his face a good deal and slightly injured one of the eyes. That day he had again received word from Oxford by telegraph which enabled him to assure the meeting that the injuries Professor Brodie had sustained were but of a temporary nature, and would not be likely to interfere with his intention of addressing them, although that occasion must be deferred for a few weeks. By way of providing for this emergency, Dr. Hofmann had, in the kindest manner, and at very short notice, come to their aid, and a paper by Mr. Mills, of Glasgow, would also be read.

The Secretary then proceeded to read a communication "*On Nitro-Compounds*," by Edmund J. Mills, Esq., B.Sc. The object of the investigation (Part I. only of which is completed) was to establish, if possible, a more satisfactory basis for the classification of nitro-compounds than any yet existing; and for this purpose the author had conceived and carried out the idea of watching the effect of one and the same reducing agent, under as uniform circumstances as possible, upon several typical nitro-compounds. Hydriodic acid was the reducing agent employed, and it was made to act upon (1) chloropicrin, which under its influence furnished ammonia, hydrochloric acid, and carbonic anhydride. (2) Marignac's oil treated in the same manner gave ammonia, nitric oxide, and, as before, hydrochloric acid and carbonic anhydride. Comparing the formulæ of these bodies (both on the marsh gas type),



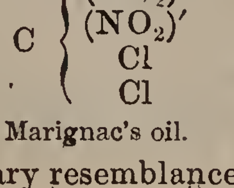
$$C\begin{cases}H\\H\\H\\H\end{cases}$$

Marsh gas.



$$C\begin{cases}(NO_2)'\\Cl\\Cl\\Cl\end{cases}$$

Chloropicrin.



$$C\begin{cases}(NO_2)'\\(NO_2)'\\Cl\\Cl\end{cases}$$

Marignac's oil.

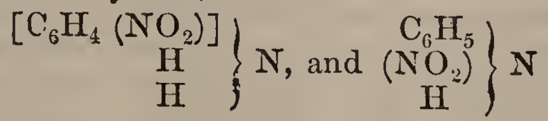
and bearing in mind their extraordinary resemblance in all points, one would naturally expect the (NO_2) to be converted into the same product in each case; but the author found that only one (NO_2) in Marignac's oil resembled the (NO_2) in chloropicrine by yielding ammonia, the other must be different from it, for it became converted into nitric oxide. Hence there were two kinds of NO_2, or "nitryl."

The Author remarked at this point, that when nitric oxide was eliminated in the presence of hydriodic acid, part of it was converted into nitrous oxide, so that in this respect there was some resemblance between HI and H_2S. Proceeding then to describe reactions with other bodies, it was stated that (3) dinitro-octylene ($C_8H_{14}(NO_2)_2$) permitted *both* the molecules of nitryl to be transformed into *ammonia*, with regeneration of octylene; but the greater part of the octylene seems, at the moment of reproduction, to be converted into a black oil, the composition of which was doubtful, perhaps $C_8H_{16}HI$(?). (4.) α. Trinitroglycerin (the explosive variety) yielded glycerin and *nitric oxide*. (5.) Nitrobenzol yielded, of course, *aniline*,—interesting inasmuch as benzol is the marsh gas analogue in the aromatic group. (6.) Hex-nitro-mannite furnished mannite and *nitric oxide*, with a very small quantity of a by-product, becoming brown at 100° C. (7.) α and β nitraniline yielded, without a doubt, the hydriodates of the corresponding phenylene-diamines, but the confirmation of analysis was yet required before this could be positively asserted. A very interesting fact was mentioned in connexion with the nitranilines. It appeared that when equal weights of these compounds were treated in a precisely similar manner with hydriodic acid, and heated together in a sulphuric acid bath, that the bulb of the thermometer enclosed within the liquid in the glass tube became completely invisible from the separation of free iodine much earlier in the case of the alpha-nitraniline than in the other tube. The weaker the hydriodic acid, the higher is the temperature at which the complete obscuration takes place. Six comparisons, with full details, were given in the paper, and the author describes the degree of temperature at which the obscuration was observed to occur. This point, where the iodine separates, is termed the "attack-point" by Mr. Mills; and its determination promises to be of great assistance in solving the problem of nitro-compounds. If very strong or fuming hydriodic acid be used, the "attack-points" are undistinguishable; likewise, the acid must not contain free iodine, or exactly opposite results will be observed; indeed, Dr. Hofmann has stated that β phenylene-diamine is readily converted by oxidising agents into blue and violet colouring matters. In the last of these reactions with hydriodic acid the difference in the "attack-point" must of necessity indicate the existence of two kinds of nitryl, which view the author brings *à priori* argument to support. The important equations described under I. and III. were verified quantitatively, but Bunsen's method of determining free iodine would not succeed in the cases where nitric oxide was liberated from the nitro-compound. The author concludes by stating a general rule to the effect that any nitro-compound heated to 100° C. with hydriodic acid of sp. gr. 1·7, will have its "nitryl" converted into nitric oxide (NO), or into "nitrosyl" or amide (NH_2), and the substances may accordingly be classified as under:—

Amidogens.	Nitroso-amidogen.	Nitrosogens.
Chloropicrin.	Marignac's oil.	Nitric acid.
Dinitro-octylene.		αTrinitroglycerin.
Nitrobenzol.		βTrinitroglycerin(?)
αNitraniline.		Hexnitromannite.
βNitraniline.		

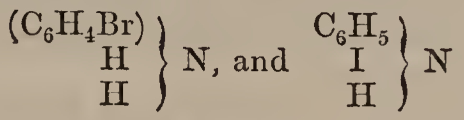
The President, in moving a vote of thanks to the author, said that, inasmuch as the subject was one which involved the adoption of new theories, he trusted there would be a full discussion upon the points raised by Mr. Mills.

Dr. Hofmann said that the remarkable isomerism of the alpha- and beta-nitranilines had frequently attracted his attention, and that from time to time he had made attempts, hitherto always unsuccessful, at elucidating this question by experiment. It having been suggested that the difference in the properties of the two compounds might arise from the different position of the complex atom NO_2 in the system, thus:—



$$\left.\begin{array}{c}[C_6H_4\,(NO_2)]\\ H\\ H\end{array}\right\}N,\text{ and }\left.\begin{array}{c}C_6H_5\\ (NO_2)\\ H\end{array}\right\}N$$

he had endeavoured to confirm or refute this view by ascertaining the number of ethyl atoms which the two compounds are capable of fixing under the influence of iodide of ethyl. Unfortunately, the ethylation of nitro-compounds presented obstacles which he had not been able to overcome. He might here mention that he had applied this process lately in another instance. Some years ago he had obtained an iodo-substitute of aniline, *iodaniline*, to the study of which he had been recalled by his researches on the colouring matters derived from aniline. Iodaniline corresponds in composition to chloraniline and bromaniline—$C_6\,(H_6Cl)\,N$, $C_6\,(H_6Br)\,N$, $C_6\,(H_6I)\,N$—but it differs essentially from these two substances in crystalline form. In his paper on iodaniline, published in the Journal of the Society, he had found, in fact, the following passage:—"When I first obtained this compound, I expected to see it crystallise in octohedrons, an anticipation which appeared to be supported by the crystalline form of chloraniline and bromaniline, and the generally assumed isomorphism of chlorine, bromine, and iodine. But I have vainly searched the different crystallisations of iodaniline for octohedrons; from all the solutions which I tried iodaniline was invariably deposited in prismatic crystals; from a boiling aqueous solution it separates after some time in long, hair-like needles. The crystalline mass obtained by the solidification of the fused base likewise exhibits no cleavage of an octohedron." Now, when lately again preparing iodaniline, it struck him that this discrepancy in the crystalline form of bromaniline and iodaniline might be due to the bromine and iodine holding different positions in the two compounds, as indicated in the following formulæ:—

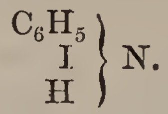


$$\left.\begin{array}{c}(C_6H_4Br)\\ H\\ H\end{array}\right\}N,\text{ and }\left.\begin{array}{c}C_6H_5\\ I\\ H\end{array}\right\}N$$

When, with the view of deciding this question by experiment, he submitted iodaniline to the action of iodide of ethyl, he was surprised to find a copious separation of iodine, the iodaniline being converted into a mixture of ethylaniline and diethylaniline, from which, by an additional treatment with iodide of ethyl, the iodide of triethyl-phenyl-ammonium was obtained. The latter he had identified by analysis. This result, although it did not finally settle the question at issue, appeared, nevertheless, worthy of remark. The coalescence of the two atoms of iodine (the one from the iodide of ethyl, the other from the iodaniline) into one molecule of free iodine would, he conceived, be water upon the mill of several gentlemen present.

The President pointed out the interest attached to this reaction as affording a new and striking illustration of the construction of the elementary molecules, to which the progress of science was unequivocally pointing, the iodine separating in this case as iodide of iodine.

Dr. Hofmann said that a similar, though less copious, separation of iodine took place when iodaniline was treated with hydriodic acid at 100°, aniline being at the same time reproduced. This reaction rendered the interpretation of the experiment previously mentioned somewhat doubtful; for although the formation from iodaniline of the iodides of ethyl-, diethyl-, and triethyl-phenyl-ammonium, would appear to prove that the radical phenyl existed intact in the original molecule of iodaniline, the separation of iodine from iodaniline by hydriodic acid suggested the possibility of the substitution for iodine of hydrogen from the hydriodic acid separated in the first stage of ethylation. Further experiments were, therefore, necessary for the final solution of the question, although there was no doubt left in his mind that iodaniline was represented by the formula



$$\left.\begin{array}{c}C_6H_5\\ I\\ H\end{array}\right\}N.$$

In conclusion, Dr. Hofmann showed the facility with which a mixture of iodaniline and toluidine by mere application of heat was transformed into rosaniline. The product obtained by fusing a minute quantity of this mixture in a test-tube imparted a deep crimson coloration to a large quantity of alcohol.

Mr. W. H. Perkin considered that the influence of heat operated as the chief cause in inducing the remarkable differences between the properties of α and β nitraniline; for whilst the one was produced by the direct action of sulphide of ammonium upon dinitrobenzol, the other had to undergo five distinct operations in its preparation, which circumstance was likely to modify the properties and, to some extent, the constitution of the product.

Professor Church inquired of Dr. Odling whether there was not a foot note descriptive of the properties of β trinitroglycerin appended to Mr. Mills's paper?

Dr. Odling admitted there was one, which he now proceeded to read. It stated that in conformity with the observations of Professor Church alpha trinitroglycerin underwent a spontaneous change, which resulted in the formation of oxalic acid, the residual undecomposed substance becoming at the same time transformed into the beta modification, which no longer possessed explosive properties. The speaker suggested that a process of reduction might often be employed as a means of distinguishing between isomeric substances; in the case of these nitro compounds, it had been shown that the same chemical means sometimes reduced the nitryl to the condition of nitric oxide, and at other times still lower, even to ammonia.

Professor Church had been in communication with Mr. Mills upon the subject of trinitroglycerin. He had himself observed the separation of as much as four ounces of oxalic acid from about a pound of the original substance; there was a small quantity of regenerated glycerin formed, but the resulting beta compound was so destitute of explosive properties that it could be heated on a platinum spatula without any detonation ensuing.

The President announced that the balloting papers for the election of the Society's officers for the ensuing year were in the course of distribution; the meeting was then adjourned until the anniversary, on March 30.

PHARMACEUTICAL SOCIETY.

Wednesday, March 16.

Professor Redwood delivered his second lecture on the "British Pharmacopœia." This lecture was devoted to a review of the galenical preparations of the Pharmacopœia. The first noticed were the aquæ. After some remarks on the various processes given in the past Pharmacopœias for the preparations of those medicines, the lecturer said he believed that the compilers of the British had selected the best of the many methods which had been directed. One point worthy of notice, however, was that waters differed somewhat, according as they are distilled from still with a high or with a low head. Among the decoctions some alterations were noticeable. The decoction of bark was now directed to be strained when cold, by which the appearance would be considerably altered. In two cases, dec. aloes and dec. cinch., it was directed that water should be added after the boiling, to make the product up to a certain quantity, and it was to be regretted that similar directions were not given in every instance. When a decoction was ordered to be boiled for a certain time, the loss by evaporation depended on the shape of the vessel, and the quantities operated upon. In a wide and shallow vessel the loss was greater than in a deep and narrow one; and similarly, when the decoction was to be boiled down to a certain point, the time the materials were exposed to the heat would vary according to the shape of the vessel. The lecturer then referred at some length to the extracts and the different modes of evaporating. He expressed his opinion that, in most instances, the alterations in the modes of preparing this important class of medicines introduced into the British Pharmacopœia were decided improvements, particularly in the case of the extract. colch. acet., the ext. colch., and the extracts of green herbs. He noticed that the Pharmacopœia directs a water bath to be employed, the temperature of which would be about 200° F., and not steam heat, which, at a pressure of 10, 20, or 30 lbs., would be hot enough to destroy the extract at the last stage. He believed that evaporation *in vacuo* would be the best method, but it offered one difficulty: the contents of the pan could not be stirred, which was essential towards the end of the process. The infusions were next referred to. In these some of the changes were not for the better. Inf. calumbæ made with cold water contained no starch, but retained the albumen, which made it as liable to spoil as before. The root was now to be used coarsely powdered instead of sliced, which was a decidedly objectionable change. The new infusion of gentian the lecturer regarded as no improvement on the old. Among the liniments those of aconite and belladonna were noticed as new and efficient remedies. The new lin. hydrargyri introduced from the Dublin Pharmacopœia the Professor showed did not keep so well as the old London preparation. The spirits, it was observed, were all changed. They were no longer spirits in the old sense, but essences thirty or forty times stronger than the spirits in the London Pharmacopœia. Among the syrups the lecturer noticed the process for making syrupus papaveris, and remarked that, though an awkward process, it yielded a good product. The most important class of galenical preparations—the tinctures—were then referred to, and the omissions, errors, and inconsistencies in the directions for preparing these were severely criticised. We leave a detailed notice of these remarks to a future occasion. In the ointments some improvements were to be remarked; but in the case of lard it was to be regretted that the flare was not ordered to be well washed before it was cut up and the fat melted out.

The lecture was attended by a crowded audience, and elicited much applause.

CHEMICAL SOCIETY OF PARIS.

February 17.

M. Ad. Wurtz *in the Chair.*

M.M. Buignet and Michaelson were elected, the first a resident, and the second a non-resident member.

At the request of the President, the Secretary read a letter from the Minister of Public Instruction respecting the recognition of the Society as an institution of public utility.

M. Le Blanc communicated a note from M. Pfeiffer "*On Rancid Butter.*"

M. Oppenheim mentioned some experiments showing that hydriodic acid when in aqueous solution is decomposed by ordinary or amorphous phosphorus, with production of the hydriodate of phosphuretted hydrogen.

M. Persoune reminded the members of a previous communication respecting the decomposition of water by phosphorus.

M. Guignet mentioned the formation of an amorphous blue deposit covered with mould, which had been formed in a solution of neutral tartrate of copper and potash.

M. Triedel, in the name of M. Crafts and himself, gave some particulars on the estimation of silicium in silicium ethyl by means of nitric acid, or of chlorate of potash and hydrochloric acid. He also gave an account of the action of bromine on silicium ethyl.

M. Personne made some observations on the method of estimating cinchonas, and pointed out that one variety of bark contained an alkaloid having the same equivalent as quinine, but differing in characters.

M. Baudrimont added some facts to those furnished by M. Personne.

M. Personne also mentioned that hydrocyanic acid might be preserved by the addition of a small quantity of an organic acid, such as formic acid.

M. Le Blanc said that M. Melsens had long employed oxalic acid for the same purpose.

M. De Luynes made some observations on the hydriodate of butylene. He described the products of the action of bromide, chlorine, alcoholic potash, and oxide of silver on this compound.

M. Baudrimont presented to the Society his memoir on the chlorides of phosphorus, written for the degree of Doctor of Science.

M. Dehérain presented the third volume of the *Annuaire Scientifique*, published with the assistance of many *savans*.

The Society has also received a number of the *Annuaire des engrais et des Amendements*, by M. Rohart.

ACADEMY OF SCIENCES.

March 21.

Some of our readers will be interested to know that a French geologist, M. Lartet, has recently explored some caverns in Syria, and found in the breccia which forms the floor bones of herbivorous animals and flint implements exactly like those found in Europe.

M. Ramon de Sagra has sent to the Academy the results of the employment of sulphurous acid gas and phosphate and carbonate of ammonia in the defecation of sugar juice. The yield of crystallisable sugar is increased from 10 to 20 per cent.

M. Nickles made an interesting communication "*On the Chloro and Bromo-metallic Ethers of Thallium.*" We shall give this paper at length, but we notice at once the way in which the author obtains the chloro-metallic ether. He passes a current of chlorine into ether, standing upon either the metal thallium or the proto-chloride of the metal. The metal or salt gradually dissolves and the flask then only contains a limpid fluid. The ether is purified by heating it on a water bath in a current of carbonic acid. A good deal of hydrochloric acid gas is disengaged, and some other chlorinated products are removed. The metallic ether is not volatile. According to the author it has the composition

$$TlCl_3,2(C_4H_5O)HCl+2HO.$$

Bromo-thallic ether $TlBr_3,3(C_4H_5O)$, shares most of the characters of the foregoing.

The existence of an *iodo-thallic ether* is doubtful.

M. Deschamps has submitted poppyheads to a long and careful examination, and now reports his results to the Academy. He states that he has found in the extracts of the capsules waxy matter, meconic, tartaric, citric, sulphuric, phosphoric, nitric, hydrochloric, and silicic acids, ammonia, morphia, sometimes a little narcotine, papaverin, and a very weak base, to which he has given the name papaverosine. In the ashes he found, in addition to those of the above-named acids which would be found there, lime, magnesia, potash, soda, iron, and manganese.

NOTICES OF BOOKS.

Address on Chemistry in its Relations to Medicine and its Collateral Sciences. By W. B. Herapath, M.D. Lond., &c., &c. Bristol: R. W. Smith. 1863.

This is the address delivered by Dr. Herapath at the annual meeting of the British Medical Association in August last, revised for general reading. It provoked some condemnation at the time in consequence of the author having gone somewhat out of his way to introduce topics which might as well have been omitted. In the revised state, parts are still obnoxious to criticism; but on the whole the address is eloquently and forcibly written, and will be found pleasant, and to some instructive, reading.

A Toxicological Chart, &c. By E. B. Stowe. London: Churchill and Sons. 1864.

Aids to memory such as this chart are sometimes condemned as encouragements to ignorance or forgetfulness. The pictures drawn in our minds, however, as Locke (we think it is) says, are laid in fading colours, and if not sometimes refreshed, vanish and disappear. A medical man who very seldom gets a poison case to treat might well be excused for forgetting at the instant the exact antidote to apply; and the best stored memories sometimes fail to reproduce a fact in a moment of excitement. We may give an illustration. We were once present when a medical student unintentionally swallowed a large dose of tartar emetic, and suffered all the symptoms of poisoning by that agent. Probably all those who were present (some four or five), if they had been asked quietly the chemical antidote for tartar emetic, would have answered correctly enough tannin. But under the circumstances, no single one thought of the remedy, and the unhappy patient was left to Providence and the stomach-pump—the latter apparently an unnecessary agent. It is in cases of this kind that a chart such as we notice proves useful, and when hanging up in a surgery it saves the trouble of looking for a book, referring to the index, and turning up the page containing the information wanted.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

156. James Wilson, Royal Exchange Buildings, London, "Improvements in hydraulic valves for working gas purifiers."—Petition recorded January 21, 1864.

358. George Davies, Serle Street, Lincoln's Inn, London, "Improvements in the manufacture of sulphuric acid."—A communication from John Smith and John Richard Savage, Philadelphia, Pennsylvania, U.S.

360. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the manufacture of super-phosphates to be employed in the making of bread, and in other purposes in the arts."—A communication from Anthony Pollak, Washington, U.S.

363. Peter Armand Lecomte de Fontainemoreau, South Street, Finsbury, London, "Improvements in photographic apparatus."—A communication from Messrs. Alphonse Liébert and Jean Lafon-Saint-Cyr, Paris.

364. James Slack, Manchester, "Improvements in filters and filtering media for filtering marine and other water or condensed steam, and the application of the said filters and filtering media to marine engines and other condensers."—Petitions recorded February 11, 1864.

372. William Drake, Sheffield, Yorkshire, "Improvements in the manufacture of iron."

414. Henry Young Darracott Scott, Chatham, Kent, "Improvements in the manufacture of cement."—Petitions recorded February 17, 1864.

Notices to Proceed.

2641. Marius Vian, Marseilles, France, "Certain compositions for preserving iron ships and other submerged iron-work from corrosion and from fouling."

2670. William Nall, Wharf Street, Leicester, "Improvements in ornamenting glass and sheet gelatine."

2680. Frederic Newton Gisborne, Adelaide Place, London Bridge, London, "An improved composition for coating ships' bottoms."

2720. Julian John Revy, Grosvenor Street, Eaton Square, "Improvements in the manufacture of explosive compounds."—Petitions recorded November 3, 1863.

2725. John Thomas, Battersea, Surrey, "Improvements in preparing ores and earths containing copper for smelting."

2753. John Muckart, Letham Mill, near Arbroath, Forfarshire, N.B., "Improvements in preserving certain vegetable substances."

CORRESPONDENCE.

Continental Science.

To the Editor of the Chemical News.

Paris, March 29.

Sir,—The number of dictionaries and encyclopædias of science is daily increasing, men of ability devote themselves to their production, and endeavours are constantly made to popularise science—that is, to express their discoveries in popular phraseology, and to avoid the technical expressions employed in works on scientific subjects. The attainment of this object is, however, materially aided by the circumstance that the phraseology of science is gradually becoming better known to the world at large; so that there is no longer the same difficulty experienced in expressing scientific discoveries in a generally understandable manner. It may be interesting to your English readers to be informed that a Dictionary of Science has been recently published by MM. Privat-Deschnel et Focillon, and edited by MM. Tandon, Masson, et Garnier, in which these ends are endeavoured to be attained. The publishers have aimed at producing a book, not only useful, but ornamental, and have intercalated in the text a number of vignettes from the hands of the most eminent engravers. It is expected that the dictionary will meet with great success.

A process for restoring writing on parchments, &c., which has faded through age, is a *desideratum*, although this problem would present no great difficulty to a chemist. M. Moride recommends the following mode of proceeding:—Soak the parchment in distilled water, then in a solution of oxalic acid, afterwards in gallic acid, and again in water. It is necessary to perform these operations quickly to avoid colouration of the surface of the paper. The dangers attending the employment of lucifer-matches have been considered by M. Dumas, in consequence of a recommendation by Dr. Lunel that amorphous phosphorus should be employed, instead of ordinary phosphorus, in the process of manufacture. It is stated that of forty-three fires occasioned by matches, twenty-one occurred through infants playing with stray ones left lying about. From this he concludes that matches fired by such slight friction as that occasioned by the foot, &c., are dangerous. He goes on to say that it might be desirable to prohibit, or at least restrain, the sale of these matches, such restriction being of especial importance to infants, who are very often the first victims of the accidents resulting from this cause.

The great convenience of matches renders it almost impossible either to prevent or restrict their use; the present form of match may, however, be replaced by a safer kind. Safety may be considered almost completely attained in those matches in which the oxidising material is placed on the end of the match, and the combustible on the box, for under these circumstances there is very little danger of fire, and this kind of match will probably in time completely replace that in use at present.

Paris, like London, is blessed with many doctors, who fill the journals and cover the walls with their advertisements; such being the case, it appeared desirable to the Commission of the General Association of Doctors of the Seine, that there should exist exact lists, comprising the names of all the doctors or officers of health authorised to exercise the art of medicine, and that these should be easily accessible. In answer to questions on this subject addressed to him by the President of the Commission, the Minister of Public Instruction states that such lists are already in existence, and carefully preserved in a special répertoire, where they can be consulted. By means of these it may be easily ascertained whether a medical man is a recognised practitioner, and the public can effectually protect themselves from quacks.

On the 20th and 21st of February a singular fall of dust is reported to have taken place at Rome, preceded by a violent south wind, the wind being followed by a great rain, and the rain being accompanied by the dust. It appeared to consist of fragments of shells mixed with silicious grains; it effervesced with acids, but a great part rested insoluble. The dust is supposed to have come from the desert of Sahara, being carried across the sea by the wind. The distance to which it was carried need not create astonishment if it is remembered that Rome is not situated much farther from the desert than are the Cape de Verd Islands, and dust has been carried out to these in such quantity as to render the air dark. In fact, it is asserted by M. Maumené that dust is sometimes carried by the wind even across the Atiantic. We are all aware of the effects of the dust brought to our own island by an east wind, such winds causing a peculiar irritation in the skin, from the presence of minute gritty particles floating in the air.

An interesting case of the healing of a large wound is mentioned in one of the French journals, the wound being caused by a bull, the sufferer being a young shepherd, whose abdomen was torn right across its largest diameter. The viscera was inundated with blood, which enclosed in its clots all sorts of foreign bodies. In spite of all these exciting causes, no inflammation took place, from the first commencement to the total healing of the wound. Two years after the accident the wound was examined —the cicatrice was solid. Seven years afterwards the patient, who was 20 years old, enjoyed perfect health, and had a strong constitution. At the left extremity of the scar there was a tumour of about the size of an egg, reducible by pressure. This, however, gave no pain, and the wound was considered perfectly healed.

The Spectrum of Carbon and the Theory of the Candle Flame.

To the Editor of the Chemical News.

Sir,—In your notice last week of M. Morren's confirmation of my experiments on the light emitted by flames containing carbon, you say you do not understand what experimentalists mean by "the vapour of carbon" as existing in a flame. M. Morren obviously means carbon in the free, uncombined state; for he says "carbon can only exist *alone*, and give its luminous reactions when it has near it the high temperature produced by the combustion of hydrogen." On referring to my original paper "*On the Spectrum of Carbon*," *Phil. Trans. Roy. Soc.*, 1862, p. 221, you will find that I simply mean carbon in a non-solid state.

Whether, in the flames of alcohol, hydrocarbons mixed with air, cyanogen, carbonic oxide and bisulphide of carbon, the vapour of carbon exist in the free or in the combined condition, is a matter on which I have never expressed an opinion. If combined it is curious that the hydrogen, oxygen, nitrogen, or sulphur with which the carbon may be associated exerts no influence on its spectrum; such a state of things would go far to show that the spectrum of a compound may simply be the sum of the spectra of its constituents. If, on the other hand, the carbon at the moment of giving light be uncombined, it is necessary to assume that in Berthelot's experiment of forming acetylene by passing an electric current from carbon poles through an atmosphere of hydrogen a portion of the acetylene is decomposed by the same force that caused its formation; for M. Morren finds that ignited acetylene also gives the spectrum of carbon.

The modified theory of the candle flame is M. Morren's, not mine. I am, &c. John Attfield.

17, Bloomsbury Square, March 21.

The Word "Radical."

To the Editor of the Chemical News.

Sir,—Since writing to you last week upon the subject of the orthography of the word "radical," I have inquired further into the derivation of this term, and referred to numerous scientific publications for the purpose of ascertaining the authority upon which the word "radicle" has been of late frequently substituted. As the result of such critical examination, I am prepared with evidence of the most conclusive character to show that the use of the original word "radical" was practically universal during the first half of the present century, and that it is still employed by some of our most eminent authors.

"Brande's Dictionary of Science, Literature, and Art," (third edition, 1853) gives the following account of the two words in question:—

"Radical (Latin, Radix—*a root*).—In Chemistry, is a term occasionally used as synonymous with *base*. The term *compound radical* is applied to certain organic combinations; in this case compounds of carbon, hydrogen, or nitrogen constitute the principal radicals.

"Radicle.—In Botany, that portion of an embryo which eventually becomes the descending axis or root."

Noah Webster, in his "Dictionary of the English Language" (eighth edition, 1860), agrees with Brande as to the meaning of the words "radical" and "compound radical," and quotes from Ure and Silliman in support of this view.

F. Accum, in his "System of Chemistry,"—London, 1803,—(vol. I., p. 15) describes the "muriatic radical" and the "fluoric radical" as bodies which had not been isolated, but of which the existence and simple nature might be inferred by analogy.

Again, we turn to the French "Abrégé de Chimie, par J. Pelouse et E. Fremy." Paris. 1853. The authors, in describing the constitution and properties of cyanogen, make use of the following words:—"Le cyanogène a fourni en effet le premier exemple d'un *radical composé*, c'est-à-dire d'un corps composé se comportant dans la plupart des réactions comme un corps simple."

M. Jourdan, in his "Traité Pratique d'Analyse Chimique" (the French translation of Rose's work, 1843), describes hydrocyanic acid as "un hydracide à *radical composé*."

In proceeding now to refer to specific opinions gathered from the published works of several eminent chemists, it is necessary to point out the circumstance that, whilst Professors Hofmann and Brodie adhere to the original word "radical," the majority of authors seemed to have changed their opinions, and adopted the other word—"radicle." There is every reason to believe that the interpretation now attached to these words is identical, notwithstanding the difference in the mode of spelling, but I will not venture to assert positively that this is the case until I have had an opportunity of making further inquiries into the matter.

I have referred to forty-nine volumes and papers by our most distinguished chemists, and I find that in thirty-three instances the word *radical* is employed, while in sixteen *radicle* is used.

It thus appears that there is a considerable diversity of opinion in regard to the correct orthography of this word "radical." I leave the reader to draw his own conclusion. I am, &c. J. S.

March 21.

[There can hardly be two opinions, we imagine, about the use of these two essentially different words. *Radicle* (Radicula) is strictly a young or little root. *Radical* (Radicalis) in its primary signification means rooted, but it is also used in the sense of primitive, inbred, and in its English substantive form correctly enough indicates a base or something from which other things take root or arise. Some chemists may conceive that there may be radicles of radicals, but in the ordinary sense of the term among chemists there can be no doubt that *radical* is the proper orthography.—Ed. *C. N.*]

Extraction of Iron from Furnace Cinders.

To the Editor of the Chemical News.

Sir,—In your paper of November 14, page 241, is found some severe strictures of Professor F. Crace Calvert, of the Royal Institution of Manchester, on my communication relating to a novel process of utilising the cinder of puddling and reheating furnaces, published in your valuable Journal, October 31, 1863.

Strictures from so able a pen as that of Professor Calvert should call forth some reply, unless the subject animadverted upon is indefenceless. It is due to the development of science, and somewhat to myself, as the discoverer of a process to render available millions of tons of valuable material that has, heretofore, been looked upon as of little or no value, to reply to those strictures. And by your leave, I beg to take up the charge of the Professor, and show wherein he is correct, and wherein he labours, or has laboured, under a misconception or non-conception of my mode of treatment.

The Professor says that in August, 1854, he took out a patent for employing cinders of puddling and refining furnaces, so as to enable iron masters to use them in larger proportions in their blast furnaces, which patent, he says, is "identical" with that of M. Fleury; and after stating the specification in that patent, adds: "I soon found that this process was not practicable, owing to the enormous expense of grinding the cinders, and afterwards mixing them with slacked lime, and making the whole into bricks; and, lastly, because the constant vibration which exists in blast furnaces, owing to the working of the engine, caused the bricks to fall into powder and to interfere with the draught, and, consequently, to impede the working of the furnace."

It is not at all to be wondered at that the cinders mixed with slacked lime crumbled in the blast furnace, and interfered with the draught, but it is somewhat to be wondered at that a professor of metallurgic chemistry should mistake the process of M. Fleury for a process so defined, as well in the specification of the patent as in its practical workings, and so mistake it as to declare it "identical." The truth is, that not a particle of slacked lime is used in the process of M. Fleury. M. Fleury has long been conscious that slacked lime has no property of cohesiveness with the mixed compound of the cinder, notwithstanding it may have, as a flux, with a molten mass.

Mr. Calvert might well apply, in 1855, for a new patent, which he says he did, per consequence of the failure of his 1854 patent to answer the expectation of the inventor; and, although his new patent is a nearer approach to the patent of M. Fleury, yet it is vastly different in several very essential and important particulars. But, before stating the particulars, let me observe that if the process with slacked lime was found not to answer, and the process with 20 per cent. of quick lime, 30 per cent. of slacked lime, or 50 per cent. of carbonate of lime, was "carried out with perfect success on the continent and in South Wales," the difference must be attributable, in the first division of that process, to the action of quicklime, and in the latter division of that process to the action of carbonate of lime on the components of the slag. The chemical action of 20 per cent. of quicklime and 30 per cent. of slacked lime on the silica contained in the slag, when in a state of fusion, is certainly very different to the chemical action of 50 per cent. of slacked lime mixed with ground slag, and water sufficient to make them into a paste. And the chemical action of 50 per cent. of the carbonate of lime mixed with slag, in a state of fusion, is also very different to 50 per cent. of slacked lime with ground slag, and water sufficient to make them into a paste. And yet another and altogether different chemical action on the silica contained in the slag takes place when the slag is ground and mixed with caustic lime, together with sufficient water (in which has been dissolved some chlorine salt) to form the slag and lime into a paste. The hydration or slacking of the lime in close contact with the silica contained in the cinder gives rise to two distinct results. First, the heat produced during hydration and the alkaline reaction of the lime induces a partial gelatinisation of the silica, and forms a strong cementing substance—a silicate of lime. Secondly, by the abstraction of the silica from the cinder an action on the protoxide and the peroxide contained in the mass is induced, which brings the former to the state of the latter, and the chlorine salt being intimately mixed with the whole mass, takes hold of the sulphur which clings to the iron, and prepares it for elimination in the furnace. Brick or blocks made of this compound will not "fall into powder and interfere with the draught" of the blast-engine, nor will they "impede the working of the furnace." This latter is my process, and you will perceive, Mr. Editor, that it is not "identical" with any of the processes patented by Mr. Calvert. The percentage of lime used by me varies to suit the quantity of silica supposed to be present in the cinder.

One word more as to chloride of sodium, and I will bring this already too lengthy communication to a close. This material has been used for the purification of metals from antiquity, or works of scientific data have led me greatly astray. I am, &c.

A. E. Fleury,

Office: Building of the Franklin Institute.

Philadelphia.

MISCELLANEOUS.

Royal Institution.—Monday, April 4, at two o'clock, General Monthly Meeting. Tuesday, April 5, at three o'clock, Professor Helmholtz, F.R.S., "On the Natural Law of Conservation of Energy." Thursday, April 7, at three o'clock, Professor Helmholtz, F.R.S., "On the Natural Law of Conservation of Energy." Friday, April 8, at eight o'clock, Dr. John Percy, F.R.S., "On Iron." Saturday, April 9, at three o'clock, Professor Frankland "On the Metallic Elements."

Indium.—Many inquiries having lately been made respecting this new metal, we may remind our readers that a very full account by the discoverers—MM. Reich and Reichter—appeared in our 8th volume, p. 280. No further description has since appeared.

Young v. Fernie.—This suit, which has continued for eighteen days, is adjourned until after the Easter holidays. It is anticipated that it will, when resumed, be concluded within a week.

Evening Instruction in Chemistry.—We have been so often applied to by correspondents wanting practical instruction in chemistry in the evening, that we may call special attention to the Birkbeck course, which commences at University College on May 3. The hours are from 7 to 9 p.m., twice a week. The class is conducted by Professor Williamson and Dr. Russell.

The Sale of Petroleum.—On Tuesday last a meeting of gentlemen interested in the petroleum trade was held at the Baltic Sale-room, for the purpose of considering certain resolutions which had been brought under the consideration of a committee appointed to report on the best rules and regulations for the conduct of this branch of trade. The following resolutions among others were agreed to:—"That the lowest point of ignition of refined oil be 100° Fahr." "That the gravity of good merchantable refined Pennsylvanian petroleum is not to exceed 812°, at a temperature of 60° Fahr.; and the gravity of good merchantable crude Pennsylvanian not to exceed 820°.

Renard *v.* Levinstein.—Our advertising columns will have informed our readers that another important suit relating to the aniline dyes is in progress. These beautiful colours seem to be almost as profitable to the gentlemen of the long robe as to the chemists who discover them, and to be as productive of litigation as they have been of scientific investigation. The patent in dispute this time is that of Girard and De Laire (No. 97, January 12, 1861) some notice of which will be found in Dr. Hofmann's paper, page 49, vol. viii., of the Chemical News, and also at page 141 of our present volume. It is for the production of a blue dye by heating red aniline dye with an excess of aniline. The plaintiffs in this case obtained an injunction from the Vice-Chancellor, an appeal for the dissolution of which was made by the defendant to the Lords Justices. The presumption of the plaintiffs appears to be that no aniline blue can be made without infringing Girard's patent; the defendants, however, allege that their blue is a different colour from that obtained by Girard's process, inasmuch as it is free from violet tinge, and that their process itself is different, as well in the nature of some of the materials used as the proportions and the temperature employed; in fact, that both the process and product are different from Girard's. The Lords Justices have dissolved the injunction on the grounds that no infringement had been proved, and that the validity of Girard's patent was open to dispute. Further proceedings are pending to establish these points. As usual, our most eminent chemical authorities are ranged on opposite sides. Drs. Hofmann and Odling, and Mr. Warrington supporting the plaintiff's case, and Professors Miller and Williamson and eminent foreign chemists appearing for the defendants. We shall await the coming trial with some interest. The case being *sub judice*, we can say nothing further on the subject; but it is clear that when such eminent authorities are to be found on each side, the chemical questions involved in the matter must be fairly open to dispute. The recurrence of such trials makes us regret the want of a proper tribunal for hearing these cases; but this case, like that of Young *v.* Fernie, will probably be tried before a Vice-Chancellor without a jury; so some decision will certainly be arrived at on this trial.

Sir John Herschel's New Theory concerning the Solar Spots.—To account for the periodicity of the solar spots, Sir John Herschel, in an article in the *Quarterly Journal of Science*, throws out a suggestion whether (granting the possibility that they may originate, directly or indirectly, in disturbances of an impulsive, vorticose, or fluctuating nature, propagated into the photosphere from the higher and more attenuated region of the sun's atmosphere) the *vis matrix*, or original exciting cause, may not be found in the circulation of an elliptic ring of planetary matter, in a state of division sufficiently minute to elude telescope vision, having a major axis such as would correspond to an average period of $11\frac{1}{9}$ years, and an eccentricity such as to bring its perihelion within the region in question; the matter of the ring being unequally distributed over its circuit, with a minimum and a maximum following in by an interval somewhat less than its semicircumference. By assuming certain conditions as to the constitution of such a ring, and the extent of deviation from exact equality in the periodic times of its component elements, he finds that not only the shorter period of $11\frac{1}{9}$ years in the recurrence of the spots first determined, but also the longer one of 56 years subsequently insisted upon by Dr. Wolf, as well as the alternate increase and diminution of the maxima of maculiferous energy, are susceptible of explanation, as well as some other periodically-recurring peculiarities in their phenomena noticed by Mr. Carrington.

Relations Between the Chemical Equivalents and the Densities of Bodies.—M Fleck, Professor of Chemistry at the Dresden Polytechnic School, finds that simple bodies form several groups, in which the relation of the equivalent to the square of the density is invariable, and that these constant volumes are generally entire multiples of the value borne to potassium. Without attaching too much importance to this rather problematical law, we believe it is of sufficient interest to attract attention. M. Fleck says that the constant quantity of potassium is the square of 7·2358,—that is to say, 52·3575—a number obtained by dividing the equivalent, 39·2, by the square of the specific weight, 0·865. The *atomic factor*—that is to say, the entire number by which this constant quantity must be multiplied for each of the simple bodies, is as follows:—

1	for potassium
2	,, sodium
3	,, lithium and barium
6	,, calcium & phosphorus
8	,, strontium
10	,, iodine
14	,, sulphur & magnesium
16	,, silicium
20	,, antimony
22	,, arsenic
24	,, bismuth
28	,, aluminium
30	,, selenium
32	,, tellurium
36	,, borax (and thallium?)
48	,, tin
54	,, silver
65	for lead
68	,, cadmium
84	,, zinc and molybdene
100	,, gold chromium and manganese
104	,, carbon (diamond)
108	,, mercury (solid)
112	,, iron
128	,, cobalt
130	,, ruthenium
132	,, copper
140	,, nickel and palladium
168	,, tungsten
232	,, platinum
235	,, iridium
240	,, osmium.

If the atomic factor for cæsium and rubidium were equal to units, their densities would respectively be 1·536 and 1·276. M. Fleck has tried to determine the atomic factors of several other simple combinations, but we will not follow him on such speculative ground.—*R. Radau, Moniteur Scientifique*, v. xxix., 63.

The British Association will hold its next meeting at Bath during the week commencing Wednesday, Sept. 14, under the presidency of Sir Charles Lyell, F.R.S.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

E. B.—We doubt whether you do come under the Act, but you had better ask your solicitor. We cannot say where you must register if you should be compelled to. Notice will no doubt be given when the districts are settled.

W. B., *E. C.*, *I. F.* received.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Thallium in Lepidolite and Mica.[*]

PROFESSOR SCHRÖTTER announces to the Vienna Academy that he has discovered thallium in lepidolite and mica. To prove the presence of this metal, he says it is not necessary to use a large quantity of the material. The author seems to take the mixture of the double chlorides of platinum with the potassium, cæsium, rubidium, and thallium, obtained from the above sources, removes the potassium, and then reduces the other chlorides in a stream of hydrogen at a low temperature. He then treats the well-washed platinum sponge with sulphuric acid, and by the repeated washing out of this obtains a solution which shows the characteristic reaction of thallium. It may be open to doubt whether the thallium in such an experiment does not come from the sulphuric acid, in which the metal may be commonly found.

On the Preparation of Toluidine, by Dr. HUGO MULLER.[†]

DR. HOFMANN'S researches on the aniline colours having shown the importance of toluidine in their formation, a communication on the preparation of this body may not be without interest. Toluidine as it is ordinarily obtained from the toluol of coal tar naphtha is fluid or semifluid; or under most favourable circumstances a crystalline mass which still retains a considerable quantity of a liquid base (aniline) from which the pure crystallised toluidine is only separated by a tedious process. This contamination with aniline arises from the fact that we are usually compelled to work with toluol, the boiling-point of which is only occasionally near that of pure toluol.

The boiling point of pure toluol as determined by Mr. Church is 103·7. The author states that he has often prepared toluol, and according to his experiments the boiling-point lies between 111° and 113°, which agrees more nearly with the determinations of Canizzaro, Noad, and others.

Toluol boiling between 111° and 113° yields toluidine as a solid, beautifully crystalline mass; but for the preparation of toluidine on a large scale it is not necessary to use toluol of a constant boiling-point. It suffices to employ a toluol the greater part of which distils between 108° and 114°. In the conversion of toluol into nitrotoluol it is necessary to use some caution, since toluol has a strong disposition to form binitrotoluol. It is best to employ sulpho-nitric acid, and, as in the case of nitrobenzol, to add the acid slowly.

The reduction of nitrotoluol by means of iron and acetic acid takes place as easily as the reduction of nitrobenzol, and the toluidine is obtained as a crystalline mass, which can be purified in the following way:—For this purpose of purification the author employs the more volatile hydrocarbon (preferably the heptylhydride $\text{Ȼ}_7\text{Hi}_{16}$) boiling between 80° and 100°, obtained from Rangoon tar or American petroleum. The latter product, which is easily procured, answers well. A simple washing with this liquid suffices to remove all the aniline from the toluidine. By solution and re-crystallisation from this liquid, toluidine is obtained in perfectly colourless crystals, which do not become brown by keeping. In this way a large quantity of chemically-pure toluidine can be easily obtained.

TECHNICAL CHEMISTRY.

On the Preparation of Iodide of Ammonium,[‡] *by Dr.* JACOBSEN.

THE author dissolves equivalent weights of pure iodide of potassium and pure sulphate of ammonia in the smallest possible quantity of boiling distilled water. One part of sulphate of ammonia will require about one and one-third of its weight, and iodide of potassium about half its weight of boiling water for solution. The two solutions are then mixed and well stirred. After the mixture has cooled, water containing 15 per cent. of alcohol is added, and the whole is allowed to stand twelve hours. In very cold weather less alcohol will suffice to separate the sulphate of potash formed. According to Schiff,[§] 100 parts of water and 10 parts of alcohol at 15° C. only dissolve 3·9 parts of sulphate of potash.

The iodide of ammonium, in consequence of its greater solubility, remains in the solution, which is now drained from the precipitated sulphate of potash, filtered, and evaporated until a pellicle forms. As the solution is very concentrated, the evaporation is quickly effected.

After the crystals of iodide of ammonium are formed, they are drained from the mother liquor, which, together with the residue of sulphate of potash, is again treated with dilute alcohol, and the liquor evaporated for a further yield of sufficiently pure iodide. Care must be taken to exclude all acid vapours from the chamber in which the evaporation is carried on; and it is well to add to the solution from time to time a few drops of ammoniated alcohol.

English Atropia!—We find the following in the *Chemisches Centralblatt* for March 19:—"English atropia is preferred to the German because its action appears to be safer. Hager believes the preference to be owing to the fact that in England *daturin* is sold instead of atropia, the former, according to Jobert, acting quite as powerfully as atropia, and causing neither pain nor confusion of vision. The dilatation of pupil caused by daturin is also said to last longest." Is either atropia or daturin made in England?

Solar Radiation.—Father A. Secchi has made a series of experiments on the intensity of the solar radiation in different seasons. His apparatus consisted of two cylinders, placed one within the other, the space between the two being filled with water at a certain temperature; the aperture of the inner cylinder is closed at one end by a plate of glass, the other is partially closed by a diaphragm with an aperture; a thermometer with a blackened bulb is placed in the axis of the inner cylinder. On presenting this instrument to the sun, it was found that the same difference of temperature between the inner thermometer and that in the water was sustained, whatever was the temperature of the water, but that the difference of temperature between the two produced by the sun at midday was almost the same in summer as in winter, although the rays had to travel about twice the thickness of the atmosphere, the cause of this remarkable phenomenon being the vapour of water in the air, which was much greater in summer than in winter, this fact fully bearing out the observations of Professor Tyndall as to the power of the vapour of water to intercept the sun's rays.

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[*] *Journ. für prakt. Chem.*, No. 1, 1864, p. 45.

[†] Abridged from *Zeitschrift fur Chem. und Pharm.*, &c., 1864, p. 161.

[‡] *Neues Jahrbuch. für Pharmacie*, bd. cxx. vii., s. 256.

[§] *Ann. der Chem. und Pharm.*, bd. cxviii., s. 365.

PHYSICAL SCIENCE.

Mr. Tomlinson's Experiments on the Electrical Fly.

In the Chemical News, vol. viii., p. 124 and p. 169, the electrical fly is referred to as a retroactive machine. "The force with which electricity leaves the points is accompanied by a proportionate recoil, which causes the fly to spin rapidly on its centre." This recoil theory has been held by electricians of repute from the time of Hamilton, who invented the fly in 1760, to our own day, Pouillet and Snow Harris still advocating it. Other writers, however, have adopted different views. Thus, Kinnersly, in 1762, finding the fly to revolve with the points backwards, whether electrified + or —, supposed the fly when electrified + to be attracted by the particles of air electrified —, which would be in greater force behind the shoulders of the fly than at the points, so that the latter would be pulled backwards. Thirdly, Beccaria supposed the fly to rotate by an expansive force due to the escape of electricity from the points whereby it drove the air forwards and the points backwards. Fourthly, Biot, Roget, Becquerel, and De la Rive adopting Poisson's view, that electricity is held to the surface of insulated conductors by atmospheric pressure, if a conductor be furnished with a point, the pressure will be at a minimum at that point, the electricity will escape from it, and if the point be free to move there will be a recoil. Fifthly, Cavallo, Riess, Ganot, and one or two others suppose that the electricity escaping easily from the points electrifies the air in the same manner as they themselves are electrified, and so there is repulsion between the air-particles and the points.

Mr. Tomlinson has recently investigated these various theories of the electrical fly, and the results of his labour are given in a paper in the *Philosophical Magazine* for March. We propose to give a short account of this paper.

The subject is considered under seven heads. 1. Historical. 2. The fly in air. 3. The fly enclosed in glass vessels, etc. 4. The fly in rarefied air. 5. The fly in liquid dielectrics. 6. The fly with the points modified. 7. Conclusions.

As a prelude to the investigation, it was thought necessary to define clearly the action of a point on an insulated charged conductor. Such a conductor throws surrounding objects into an opposite electrical state, and the intervening air is polarised. By means of the air discharging itself upon the prime conductor the charge is gradually dissipated. If a point project from the conductor, the lines of force accumulate more easily upon it than upon any other part, and discharge takes place with sufficient rapidity to produce the electrical aura or gale of wind; that is, supposing the conductor is kept charged by working the electrical machine. Under such circumstances, each polarised particle discharges itself by its opposite side upon the point, and becomes electrified as a whole with electricity of the same name as the point. It is then repelled by, and repels the point, so that the latter, if free to move, will thus be set in motion. This is Dr. Faraday's convective discharge theory applied to the explanation of the electrical fly in the air, and it is quite satisfactory, as may be abundantly proved by experiment. The difference between Mr. Tomlinson's theory and that of Cavallo, Riess, and Ganot is this:—They suppose the electricity to pass off readily from the point, and so electrify the air; whereas it is the air that fetches the electricity from the point, becomes electrified in the same manner, and thus produces repulsion.

If the fly on its supporting point be held at some distance from the prime conductor of a machine in action, it will rotate briskly. If insulated it will not rotate. In the one case the polarised air can discharge upon its points; in the other the fly is rendered polar like the air, and is seeking to discharge upon the prime conductor. If the uninsulated fly be enclosed in a bell glass it cannot rotate, because the circulation of the polarised particles is arrested. If a chain from the prime conductor be connected with the metal support to the fly (insulated) there will still be no motion, for a similar reason; but if a point be held near the outside of the bell-glass, the fly will rotate briskly, because in such case the jar can become charged. The electricity of the fly is conveyed by the air to the inner side of the glass, and the point dissipates the electricity of the same name from a portion of the outside of the glass. In like manner, when the inside of a bell-glass is electrified (by allowing a chain from its prime conductor to rub against its inner surface) and so placed over the fly, its metal support standing on a copper disk on a glass-legged stool, there is no motion until the copper disk and a portion of the bell-glass be touched by the hand; the fly then starts off with great speed, but comes to rest as soon as equilibrium is attained. It may be set going again by again discharging a portion of the glass, and so on many times.

When the air in the bell-glass is rarefied to about 1-inch pressure the electrified fly does not rotate when a point is held outside, because in such case the particles of air are not sufficiently numerous to produce mechanical force.

When the fly is held near the knob of a charged Leyden jar, it is first attracted and then repelled, the air between the knob and the points discharging upon the latter, and so producing motion as before explained.

When the fly is placed on a supporting point in liquid dielectrics, such as turpentine, paraffine oil, benzole, &c., which are connected at opposite points with the prime conductor and the earth, a powerful current is produced, whereby the liquid is thrown into a kind of whirlpool, in which the fly is swept round, not as in air with the points backwards, but with the points backwards or forwards, according to the direction of the current, and this depends on the position of the conducting wires. By adjusting these, the current, and with it the fly, can be made to rotate from left to right or from right to left at pleasure. The liquid should be placed in a shallow glass dish six inches or more in diameter.

A good illustration of the mode in which the particles circulate and discharge upon the electrified wires was obtained by removing the fly and the supporting point from the liquid, and stirring up in it a number of particles of gold and silver leaf. On placing a wire from the prime conductor in the liquid and holding a point connected with the earth over the liquid, the metallic particles started asunder, became polarised, and began to circulate in the most orderly manner between the two wires. The particles arranged themselves in parallel lines, moved towards the + wire, discharged upon it, became electrified +, were repelled, and passed in an opposite direction outside the parallel lines to the — wire, discharged again, and joined the parallel forces that were moving towards the + wire. This experiment renders visible the action that we must suppose to take place between the electrified particles of air and a point attached to a charged conductor. It also renders the behaviour of the fly in air quite clear.

When the points of the fly were struck into little pellets of bees'-wax, the fly in air did not rotate with the points backwards, as usual, but with the points forwards. Now, under ordinary circumstances, the convective discharge on each point is marked by a brush, showing that the polarised particles are discharging on the point, and becoming similarly electrified produce repulsion. If the point is concealed, discharge cannot take place upon it, but it does so on the nearest approach to a point that the apparatus affords, and that is the bend or shoulder of the fly. A brush, visible in the dark, may be seen from the shoulder, and this, as before, producing motion by repulsion, sends the fly round with the bees'-wax knobs forwards. It is, however, very curious that if a lighted candle or the flame of a spirit-lamp be brought near the fly while thus rotating with the wax knobs forwards the motion will slacken, cease, and then set in with the knobs backwards, just as if the points were quite free. In such cases the flame, and the hot air about it, rob the fly of most of its electricity, and act by repulsion upon the most prominent parts of the fly, namely, the wax knobs. In such case the brushes disappear from the shoulders of the fly.

The conducting action of flame was shown by placing a metal pointed stand connected by a chain with the prime conductor on a porcelain dish containing spirits of wine. On working the machine the fly on the point spun rapidly, but when the spirits were kindled the fly stopped, and did not begin to spin again until the flame had died out.

The conclusions to which the author is brought by his various experiments is (1) that the fly in air rotates by repulsion as before explained, (2) that it does not rotate in vacuo or in highly rarefied air where the particles of the dielectric are not in sufficient force to produce mechanical action by repulsion, (3) that the fly does not rotate under cover unless means be taken to allow the dielectric to circulate, (4) that in liquid dielectrics the fly has no distinctive action, but is swept round by the current excited in the liquid, either from left to right or from right to left, according to the position of the conducting wires; (5) that the fly in air may be made to rotate with the points forwards or backwards, if means be taken to transfer the brush which marks the convective discharge from the point to the shoulders, or *vice versâ*, (6) that the action of flame is to draw off electricity of the same name as that of the fly, and so produce repulsion.

The general conclusion is, that "there is no one expression that fairly represents the electric fly. It modifies its behaviour according to circumstances; and like a good subject, has no law of its own, but conforms to the laws of the community of which it is a member."

Replacement of Species.—Dr. Hooker has made some interesting remarks "On the Replacement of Species in the Colonies and Elsewhere." As examples, he brings forward the Cardoon in the Argentine provinces, the Anacharis in the rivers of England, and some very remarkable cases of importation of weeds to Australia and New Zealand. In New Zealand the cow grass is rapidly spreading all along the sides of the main lines of roads; the dock is to be found in every river-bed, the sow-thistle is spread all over the country, and water-cresses threaten to choke up the rivers. A saying of the native Maories is that "as the white man's rat has driven away the native, so will the European fly do; and as the clover kills the fern, so will the Maories disappear before the white man." Many other instances of replacement are given.

PHOTOGRAPHY.

The Magnesian Light.

Photographers are indebted to the perseverance of M. Sonstadt for the removal of a great obstacle. Every one knows the difficulty which has hitherto been experienced in getting a powerfully actinic artificial light. Such a light is, however, furnished by the combustion of the metal magnesium, and, thanks to M. Sonstadt, this metal is now procurable at a price which makes it available for practical purposes.

Magnesium is an easily-inflammable metal. A wire of considerable thickness can be ignited in the flame of a candle, and the light evolved by the combustion is of great intensity. It has been ascertained that a wire of 0·297 millimetre diameter will give as much light as twenty-four stearine candles of five to the pound. The powerfully actinic character of the light has been recently demonstrated by Mr. Brothers, of Manchester, and Mr. Sydney Smith, both of whom have produced good pictures by its use.

The metal is neither ductile nor very malleable. It cannot be drawn, but by employing a method devised by Dr. Matthiesen it can be forced in a softened state through a small opening in an iron cylinder, and thus strands of wire of considerable length can be formed. The wire has been found to burn more steadily when three or four strands are twisted into a rope; and a simple clockwork arrangement will deliver such a rope to a spirit or oil lamp, in the flame of which it may be burned.

We look for important results from the use of this light. The opportunities for its use are numerous; and we may expect our collections to be soon enriched with pictures of objects hitherto shut out from photographers.

Some are talking wildly of "night pictures," as though they expected, by means of magnesium, to obtain a picture of the gloomy effects of midnight on a scene. The principal use of the light will, of course, be for dark interiors; and we hope soon to see the magnificent grottoes of Adelsberg and Antiparos—which the pencil is as powerless to draw as the unaided camera to depict—revealed as brightly as the caverns in the glaciers, so well known to photographers. Another Frith may also show us the wonderful passages in the interior of the Pyramids more clearly than they have ever been seen by the traveller with the help of the two or three candles which light his way through the dark labyrinth, and enable us at our own firesides to gaze with awe on the vast range of subterranean tombs at Serapeum. All these and many more objects are now open to an enterprising man, who will no doubt soon be found to avail himself of them.

New Application of Photography.—A somewhat new application of photography, to which the name orography has been given, has lately been made. M. A. Caville has applied it to the examination of the geology of the Saint Gothard and the Canton des Grisons; he has prepared four panoramas, and a number of views of details. Geology will be greatly assisted by this application of the art of photography.

Reduction of Photographic Ashes.—Davanne recommends two and a-half parts of white sand and five parts of dried carbonate of soda to be mixed with ten parts of ashes. The addition of the sand makes a more liquid flux, and the silver runs together more easily.—*N. Jahrb. für Pharm. B.*, xx., s. 150.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture VIII.—*Saturday, January 16, 1864.*

We shall proceed this morning to the subject of magnetic oxide of iron, which we mentioned on the last occasion. Magnetic oxide of iron consists of three equivalents of iron and four of oxygen—Fe_3O_4. It occurs beautifully crystallised in nature, and may also be prepared artificially, well crystallised. In this large vessel before you, we have made a specimen of it, in the amorphous or non-crystalline state, by mixing together two chlorides of iron—the protochloride and the sesquichloride—in such proportions that when an alkali is added to remove the chlorine, the two oxides shall be precipitated conjointly. When they are thus thrown down in contact with each other they unite, and form magnetic oxide of iron. We have, then, one mode of its production in the wet way—a very ordinary mode. Here is some of the same compound—(in fact, I might call it a salt)—which we have dried; and you see that it can be taken up by the magnet immediately. We have here clear evidence of the artificial formation of this oxide of iron in an amorphous condition. Here is the specimen to which I referred on the last occasion as a furnace product occurring in a form which is exceedingly rare. I have only found it once at present. It is in the form of rhombic dodecahedrons. The ordinary form of this product is the regular octahedron. We have, then, positive proof of the formation of this compound by the dry way. It is produced by the action of steam on metallic iron, and sometimes you obtain it thus in fine crystals. It is produced also by the roasting of carbonate of protoxide of iron. Roasting operations of this kind are very extensively performed in this country. The iron ores from our coal measures are all carbonates of iron, and before they are introduced into the furnace they are roasted. During this process we frequently discover in the roast heaps fine crystals, or tolerably fine crystals, of magnetic oxide of iron. Again, this oxide is not unfrequently produced in fine crystals in various furnace operations, as in the conversion of pig-iron into malleable iron in the puddling furnace. It is produced when sesquioxide of iron, that is, the red oxide, is exposed to a high temperature, oxygen being then liberated, and magnetic oxide of iron being left. When silicate of protoxide of iron is exposed to a high temperature in admixture with carbonate of lime, or lime, the silica is displaced, forming silicate of lime, and magnetic oxide of iron is produced. This experiment we owe to the late Professor Ebelmen, who conducted it in a porcelain furnace at Sèvres, of which he had charge. Crystallised magnetic oxide of iron may be formed by heating chloride of calcium with sulphate of protoxide of iron—common green vitriol, in a covered crucible. Kuhlmann obtained it in that way. It is produced also by the action of the vapour of fluoride of iron on molten boracic acid. This result we owe to Mitscherlich.

There is one observation of Becquerel which should not be omitted. He found that on an iron bar from the foundation of an old castle which had been under water there were three layers. The outermost layer consisted of hydrated sesquioxide of iron; the second of anhydrous or red oxide; and the third, or innermost, of magnetic oxide. The layers of red oxide and magnetic oxide were distinctly crystallised.

Magnetic oxide of iron occurs abundantly in nature, forming in some places truly mountain-like deposits. This is the case at Gellivara in Lapland. We have very fine specimens of the ore at Arendal in Norway, in various localities in Sweden, in the Ural, and in Canada. It occurs in enormous masses, and also in beds. Sir William Logan, in his description of the minerals of Canada, has given an account of several very large beds of magnetic oxide of iron. He says they present exactly the appearance of stratification, and this appearance occurs also in other districts. Some of the beds are of enormous thickness. One to which he refers is twelve feet thick. That is a very small bed comparatively. There are some 200 feet thick, and some much thicker even than that. At Arendal it occurs in granite and in gneiss, along with augite and garnet. It is found also in serpentine in association with garnet, hornblende, and augite, as as in Bohemia; in association with greenstone, granular limestone, garnet, hornblende, augite, and quartz, with augitic porphyry at Blagsdat, in the Ural; and in drusy cavities filled with crystals both of magnetic oxide of iron and iron pyrites. The association of these two minerals is worthy of note. It also occurs with calcspar and analcime. In Thuringia it is found in hypersthene rock along with crystallised carbonate of iron. Another mode of its occurrence of extreme interest, as bearing upon the conditions under which it was formed, is its association with dolomite in Canada. Sir William Logan has described its dissemination in this substance. It is found also in basalt as at Taberg. The magnetic quality of certain basalts is supposed to be due to the presence of this magnetic oxide of iron disseminated through their mass. There is also another view—namely, that put forth some years ago by Professor Andrews, of Belfast, that some of these rocks contain metallic iron disseminated through them. When a portion of these rocks was pounded, and brought into contact with copper salts, metallic iron was thrown down, but I am not sure that Andrews's conclusion was actually a correct one. The magnetic oxide occurs also in lava at Monte Somma, in various sedimentary rocks, and in clay slates in France. There is a singular variety occurring in the lias beds at Rosedale and Pickering in Yorkshire. It is a very remarkable ore, containing a large amount of carbonate of iron. It has a dark bluish grey tint, sometimes more or less green, and it is not only magnetic, but frequently polar. I received this specimen of Rosedale ore from Professor John Phillips some years ago. It is perfectly amorphous. There is no evidence whatever of the crystals of which I have spoken. The magnetic quality of this iron ore in the north well deserves attention. Magnetic oxide is found in lodes in schist in Siegen. The lode is traversed by a dyke of basalt, and the sides of this dyke consist of magnetic oxide.

We see, then, that this remarkable compound, which so abounds in nature, occurs under very dissimilar conditions. Opinions are diverse as to the mode of its formation. Some stoutly maintain that under all circumstances it has been formed by igneous action, and injected or ejected like a volcanic rock; but there are in many cases some serious objections to this view. I am not prepared to say that magnetic oxide of iron in nature has never been the result of igneous action. I feel perfectly sure that in some cases it has been produced in that way. Its occurrence in lava, for instance, establishes this fact. But there is one point in connexion with some of these deposits of magnetic oxide of iron which demands particular attention in connexion with this igneous theory—namely, the presence of free silica in it. I have mentioned some cases in which free silica exists in the magnetic oxide of iron and various silicates. It is impossible to conceive that at a high temperature silica and magnetic oxide of iron could ever have come in contact without immediately combining and forming silicate of iron, the oxide of iron having a very strong affinity for silica. Even when magnetic oxide of iron is heated with silica, some of the oxygen is pretty readily displaced—the excess of oxygen beyond that required to constitute protoxide, and the silicate of protoxide of iron is formed. Thus, the presence of free silica in these deposits of magnetic oxide of iron is, I think, a strong proof that there, at least, it could never have been the result of igneous action. So, also, with regard to some of the silicates occurring in association with the magnetic oxide of iron in various deposits. There is no doubt, I think, that combination would have taken place between them and the oxide of iron to a much greater extent, at all events, than is the case. On the other hand, there are cases in which, in all probability, the oxide of iron has been, or may have been, injected. The mode in which this substance has been deposited in the amorphous state is very curious, and is at present, I think, very obscure. I cannot clearly understand all the conditions under which it has been formed. Undoubtedly, it has been derived in a great measure through the carbonate of iron there existing. I shall again have occasion to recur to some of the iron ores in which an oxide of iron resembling the magnetic oxide is present. When occurring in dolomite, the magnetic oxide must have been formed in the wet way. On the last occasion I showed you large and magnificent octahedral crystals in chloritic schist; and here, again, I think there is no doubt whatever that it must have been formed in the wet way. Its occurrence, also, in certain localities in a distinctly stratified state is suggestive of its aqueous origin under these conditions.

We now pass on to the consideration of the silicates of iron.

Anhydrous silicate of iron—silicate of protoxide of iron—is a frequent product of metallurgical operations. It occasionally occurs in beautiful crystals. I spoke of it on a former occasion under the head of iron chrysolite or olivine. I have here on the table numerous crystals of it which have been produced during metallurgical operations. It is a tribasic silicate of protoxide of iron. It consists of three equivalents of the protoxide, and one of silica—$3FeO,SiO_3$. The oxygen of the silica, therefore, is just equal to that of the base, and that is the most stable compound. We have made many experiments upon this of late. It has been supposed that higher silicates exist, some containing four or five or six equivalents of base. We have in every case failed to make them. In some experiments a quantity of oxide of iron and silica were mixed together in the proportion to form these higher silicates; and certain products have been obtained by means of heating such mixtures in crucibles. It has been supposed that true and definite silicates have been thereby formed. There is, however, an error in the mode of conducting the experiment when we attempt to make a more highly basic silicate than the one the formula of which I have given. We have conducted the experiments in iron crucibles, as clay crucibles cannot be used for this purpose. By fusing the silica and the oxide of iron together at a high temperature they unite and become suddenly liquid. If there be more oxide of iron than is sufficient to form that tribasic silicate, on attempting to pour out the liquid we always get the tribasic silicate poured out, and there remains behind a comparatively infusible, or partly infusible, mass containing magnetic oxide. If we had left the whole mass to cool in the crucible we might have concluded that combination had taken place throughout, and we should, therefore, have been led into error. When we attempt to pour out the product mass we find that what appears molten consists of a mass partly molten and partly semi-fluid. It is important to note that artificially, at all events, we cannot make a silicate containing more base than that represented in the formula before you. This tribasic silicate of iron was reported many years ago to have been found in the Mourne Mountains, Ireland, by Dr. Thompson. He described it as a distinct mineral. I made most particular inquiry about it, and got a specimen which was said to have come from the same locality, but it turned out to be nothing more than a piece of slag of some kind.

I have already spoken of the action of silica upon sesquioxide of iron at a high temperature, stating how it displaces the excess of oxygen and forms silicate. This silicate of iron in the hydrated state we can produce by way of double decomposition. If, for example, we take silicate of soda and a protosalt of iron and mix them together, double decomposition occurs, and the silica goes down in combination with the oxide of iron. It has a dull greyish green colour which, I think, you will recognise here; it is very similar to that of the green sand of geologists which, in fact, is supposed to be due to a hydrated silicate of iron.

There is a silicate of sesquioxide of iron—not one of the most satisfactory minerals in the world—termed cronstedite.

The next compound of iron to which we shall direct attention for a few moments is one of considerable interest—namely, the phosphate of iron, or vivianite. There are several phosphates of iron. There is one consisting of two equivalents of protoxide of iron, and one of phosphoric acid, $2FeOPO_5$. It is formed by the direct action of phosphoric acid upon iron. There are various other salts, one of which is formed by the addition of common phosphate of soda to a solution of sulphate of protoxide of iron. This phosphate quickly becomes bluish grey on exposure to the air. It dissolves slightly in water containing carbonic acid. The degree of solubility has been determined in the laboratory upstairs some time ago. It corresponds to about 0·54 parts by weight in 1000 parts of water containing carbonic acid. There is a natural phosphate of iron known as vivianite, which is a mineral of great interest. It is of a blue colour, and is a pseudo-morph of another phosphate which contains variable proportions of sesquioxide of iron resulting from atmospheric oxidation. It contains the two oxides of iron protoxide and sesquioxide. It occurs beautifully crystallised as well as earthy and amorphous. You sometimes get the amorphous variety out of boggy ground where bones have lain for a very long time. I remember that some years ago, while they were making the railway in the meadows under Castle Bromwich, near Birmingham, very fine specimens of this kind were dug up out of the ground. They are of a pale bluish colour; and sometimes when old bones which have been interred for a long time are dug up, they are found to be more or less blue, owing to the formation of this phosphate. In an old mine in Upper Silesia a human skeleton was found, several of the bones of which presented, in the interior, crystals of vivianite and blue-grey spots. The mine had been worked in the thirteenth century, and it is not known how long the skeleton may have been there. Sandberger found in horses' teeth taken out of a boggy meadow, crystals of vivianite from one to one and a-half line in length. They were as clear as water, had a very bright lustre, and gradually acquired a smalts-blue colour by exposure to the air. My friend Dr. Müller has in his possession a fragment of bone of a sheep in which the internal cancellated part contains small, acicular crystals of blue vivianite having a remarkably bright lustre. This specimen was found near Schleitz, in Saxon Voigtland. According to Bischof, when a solution of carbonate of protoxide of iron in water impregnated with carbonic acid is mixed with a solution of phosphate of lime in the same solvent, and kept without access of air, turbidity occurs after a time, and is followed by the deposition of yellowish white phosphate of protoxide of iron. Colourless crystallised tribasic phosphate of iron, of the formula—

$$3FeO,PO_5+8HO,$$

has been found in Delaware. This was perfectly colourless at first, but it became blue or bluish grey on exposure to the atmosphere.

We now come to the carbonate of iron. This is an extremely important salt in a commercial point of view. It is carbonate of protoxide of iron. You have specimens of it here before you. Here is a lump of it more or less impure. Sometimes it occurs of great purity. These rhombic crystals consist of this substance. It is anhydrous, and consists of one equivalent of protoxide of iron, and one of carbonic acid. It occurs abundantly in nature, and is found in geological formations of nearly every age. It is decidedly our most important iron ore. It is that which occurs so extensively in coal measures. It crystallises like calcspar in the rhombohedral system. It then forms a mineral termed spathic ore, or sparry iron ore. The natural mineral almost always contains a large quantity of carbonate of protoxide of manganese, and generally, also, some carbonate of lime and carbonate of magnesia. The manganese plays a very important part with reference to the application of this ore in various metallurgical operations. The specific gravity of the native crystallised variety ranges from 3·7 to 3·92. Senarmont obtained it crystallised in the form of a greyish-white sand, hardly attackable by dilute acids; it remained nearly unchanged in dry air, and very slowly acquired a pale brown colour in moist air. He produced it by exposing a mixture of sulphate of protoxide of iron and carbonate of soda, or of protochloride of iron and carbonate of lime, in hermetically-sealed glass tubes, in the first instance to a temperature of 150 degrees centigrade, or beyond—that is, with the sulphate of protoxide of iron and carbonate of soda; and in the other case to a temperature of from 130 to 200 degrees during from twelve to thirty-six hours. The salt was darker in colour, and more permanent in the air, the higher and longer the duration of the temperature employed. The form of the crystalline mass was distinctly rhombohedral. It is obtained anhydrous when thrown down by the addition of carbonate or bicarbonate of potash or soda to a solution of protochloride of iron. A bulky precipitate of carbonate of protoxide of iron is obtained, which very rapidly absorbs oxygen from the air, becoming at first green, and afterwards brown.

Carbonate of protoxide of iron is slightly soluble in water, but the solubility is increased considerably by the presence of carbonic acid. In this state it exists in mineral or chalybeate waters.

We will now speak of the carbonate of sesquioxide of iron. Formerly, no such compound was believed to exist, but of late experiments have been made which show that there is some reason for admitting its existence. It is only prepared under certain circumstances, and is very easily decomposed.

Bischof states that the solubility in pure water of carbonate of protoxide of iron is as follows:—10,000 parts of pure water dissolve 28·09 of the precipitated carbonate in from three to four hours; and of the natural carbonate, commonly called sphærosiderite, the same quantity of water dissolves only 6·0755 parts. The mineral is dissolved more rapidly by the application of heat, but at the same time it is quickly decomposed. If the decomposition is such as takes place when carbonate of copper is heated to redness, there would be only liberation of carbonic acid; but the protoxide of iron has a very high affinity for oxygen, and at a high temperature it partially decomposes the carbonic acid, reducing it to carbonic oxide. Thus, when you heated carbonate of protoxide of iron to redness you get carbonic acid and carbonic oxide evolved; and, instead of protoxide of iron remaining, you get protoxide in association with a certain portion of sesquioxide.

The carbonate of iron occurs in beds and lodes, sometimes in enormous masses, as at Eisenerz, in Styria, and Stalberg, in Prussia. At Siegen, it occurs in lodes in clay slate. We have it in lodes in this country. I very well remember a lode at Alston Moor, Cumberland. It was not very pure, but it was in a lode, nevertheless. It occurs beautifully in Somersetshire; very fine crystallised specimens are obtained there. All our argillaceous iron ores, or clay iron ores, consist essentially of carbonate of protoxide of iron. These occur abundantly in our coal measures, and are the chief sources of iron in this country. The carbonate occurs also in the lias, oölite, wealden, and eocene. Not a very long time ago, when I was down in South Wales, I saw a large quantity of iron ore which had been dredged up by the fishermen at the Isle of Wight, and taken to Cardiff, and there sold at about 10s. a ton. The pieces were rounded by the rolling action of the water. It is a curious thing that fishermen should have been engaged in dredging up iron ore. There was a large quantity sold in this way. Sometimes in clefts in our coal measures we find beautifully crystallised carbonate of iron.

With regard to the conditions under which this carbonate of iron has been deposited in nature, it is certain that it must have gone down from water; but one condition which must have existed is the absence of oxygen to peroxidise the iron. That is perfectly certain. If you bring atmospheric air in contact with carbonate of iron dissolved by carbonic acid in water, you will most assuredly peroxidise the iron, and separate the carbonic acid.

I shall now present to you some remarks concerning the constituents of these important clay iron ores. They are, as I said, essentially composed of amorphous carbonate of protoxide of iron; but they always contain, in addition, carbonate of manganese, carbonate of lime, carbonate of magnesia, clay, and phosphoric acid in combination with lime, invariably, without any exception whatever. I think they also always contain a little sulphur, as bisulphide of iron. I have never seen it absent. They contain other occasional matters. We have made here a very large number of analyses of these carbonates of iron, almost all of which occur in this country. The work occupied some years, and was completed four or five years ago. I will go over the constituents again, lest I should have omitted any. These ores contain protoxide of iron in combination with carbonic acid. Sometimes we find a little sesquioxide of iron. Then there is protoxide of manganese, alumina, lime, magnesia, potash, silica, carbonic acid, phosphoric acid, sulphuric acid, bisulphide of iron, a little combined water, and a little organic matter, or sometimes even a large amount, as in the black band pyrites. Those are all. The silica exists in combination with alumina, and a small quantity of iron, forming clay. In fact, these ores are mixtures of impure carbonate of iron with clay. The clay has exactly the composition of fire clay. If we take fire clay and clay occurring in association with these ores and analyse them, we find they have the same composition; and what is singular, and what we were not exactly prepared to expect, is that when we dissolve these iron ores in dilute hydrochloric acid, as is commonly done, there remains behind an insoluble residue of clay, and the greater part of the potash which the ore contains, which varies in amount from 1 to 2 per cent., will be found in that insoluble residue.

All these clay iron ores are very much alike till we come to those which are found so extensively in Yorkshire and Northamptonshire, and which also consist essentially of impure carbonate of protoxide of iron. The Yorkshire variety apparently contains in addition some silicate of iron. We have examined with great care one from Cleveland. It has a green colour, and it contains in a state of combination silica in a gelatinous form, or silica which separates in a gelatinous form, which shows that it was in a state of combination, and, as far as we can make out, it is silica combined with protoxide and sesquioxide of iron. There are, however, difficulties in connexion with this subject which we are not yet able to explain. In this Yorkshire ore you will see a grey infiltration, not at all unlike what appears in the other specimen. The two are very much alike. You can hardly distinguish one from the other. It is these which, I think, contain silicate of iron; but that is a point requiring further investigation. This ore contains also beautiful little infusorial shells of silica, left by the action of the acid. One point of great interest, also, is that it contains the well-known mineral called anatase, which is oxide of titanium. This is the only case, I believe, in which that mineral has been detected in these ores. The ore was submitted to the action of acid, and the acid left small dark spots, which were submitted to Professor Miller, of Cambridge, and after being examined under the microscope were pronounced by him to be anatase. They were also determined to be anatase by chemical analysis, independently of the microscopic investigation. Titanium is very generally present in our iron ores, although we do not often detect it in our analyses, because it is very difficult to find it, yet it almost always makes its appearance in our blast furnaces, occurring in the hearths in the form of little red cubes. Mr. Riley has been lately examining fire clays with reference to the presence of titanium, and he says that in all our fire clays, without exception, he has succeeded in finding titanium in the state of titanic acid.

I have spoken of the accidental occurrence of copper in our iron ores. It occurs in the form of copper pyrites. I have also referred to the presence of blende, or sulphide of zinc. Sulphide of nickel is occasionally found, especially near Merthyr, and it forms some of the most beautiful crystals you could wish to see—delicate hair-like crystals, called "Haarkies" in German, or Millerite in English geological nomenclature, so christened by Mr. Brooke after Professor Miller, of Cambridge. I have spoken of the occurrence of lead, and shown you specimens of it. There is also another metal of considerable interest which occurs in these ores—namely, silver—the last thing you would expect to find there; but Mr. Dick, on examining some of the black-band ore from New South Wales in the laboratory above some years ago, got evidence of the presence of silver. It has been extracted from the ore by the wet as well as the dry way. The proportion is about half-an-ounce to the ton. We find occasionally a peculiar fat-like body, containing a very large amount of carbon—namely, hatchettine—in some clay iron ores, especially in South Wales, where it occurs along with Millerite.

These impure carbonates of iron have undoubtedly all been deposited as so much fine mud under conditions in which oxygen was certainly excluded. There are many ways in which we might possibly explain this condition—perhaps the evolution of carbonic acid abundantly, carburetted hydrogen, and so forth; but oxygen there could not have been, because the carbonate of iron would most undoubtedly have been converted into sesquioxide of iron. Here is a specimen illustrating that change, upon which I have dwelt already. It is a piece of clay iron ore picked up from the coast at Hastings, having fallen out of the cliff. You will find that the whole of it has become coated with hydrated sesquioxide of iron, the carbonite of protoxide having disappeared, and the protoxide having been peroxidised. Here is a specimen of Cleveland ore, which is greenish grey, or greyish green in the interior, and which consists chiefly of carbonate of protoxide of iron, mixed with the so-called greenish silicate. By weathering action, it has become coated with this very unattractive deposit of hydrated sesquioxide of iron. As we get further down we find sometimes pure carbonate of protoxide of iron, or the impure variety—common clay iron ore, in fact; and occasionally we get beautiful specimens containing a nucleus of clay iron ore, surrounded by hydrated sesquioxide such as you have there. There is a very singular variety of clay iron ore here. There is a curious story connected with this lump of mineral, though it is not at all attractive to the eye. It was raised in Wales some time ago, and thrown away by the miners as worthless. It was put upon the pit-mounds as of no value; but it turned out to be a valuable iron ore, containing about 30 or 40 per cent. of iron. At first it was sold at about a shilling a ton; but its value soon became recognised, and its price went up to something like thirteen or fourteen shillings a ton.

ACADEMY OF SCIENCES.

March 28.

M. Kuhlmann continues his "*Researches on the Preservation of Building and Ornamental Materials.*" The present part is occupied with further details on the nature of the colouring matters of minerals. The author notices accidental changes of colour in Roman buildings from the presence in the mortar of sesquioxide of iron, which, becoming dissolved by rain water and carbonic acid, penetrates the marble or travertin, and is again deposited as the carbonic acid escapes. The contact of iron clamps, he notices, will also occasion the colouration of stones. Besides these accidental colourations, natural changes of colour result from the slow decomposition or oxidation of colouring matters. Organic matters will disappear, oxides in a low state of oxidation will pass to a higher, and in stones buried in the ground reduction will take place, &c. The slow decomposition of silicate of iron will also cause the production of yellow stains in porous siliceous stones. M. Kuhlmann believes that we have still much to learn respecting the colouring matter of precious stones, and he proceeds to explain a simple and expeditious way of analysing silicious stones, which will afford the means of recognising the true cause of colouration. He calls it analysis in the gaseous way, and it consists in passing dry hydrofluoric acid over the mineral heated to dull redness. The apparatus used is made of platinum. It consists of a retort in which to generate the gas, a tube to hold the boats containing the mineral, tubes to connect these, and finally tubes to carry the vapours to a caoutchouc bottle furnished with a little water. The volatile fluorides condense in the bottle, while most of the metallic oxides associated with the silica remain in the boat in the form of fluorides. Fluoride of iron, however, is volatile, and must be looked for with the fluoride of silicium. This method of analysis, M. Kuhlmann says, possesses immense advantages over the processes commonly used. By means of it he has proved that no metallic oxide exists in the amethyst, that hot hydrofluoric acid decolorises emeralds and yellow quartz, but does not change the colour of smoky diamonds, yellow diamonds, or rubies, while it turns blue sapphire violet. (The author must be spending a fortune in precious stones.) Lastly, M. Kuhlmann states that red cornelian, which is decolorised both by oxidising and deoxidising agents, and which, therefore, he formerly considered to be coloured by organic matter, leaves a ferruginous residue in the platinum boat when treated by the foregoing process—an apparent indication that the iron is present in the mineral in a peculiar state of oxidation or molecular engagement.

A report on two memoirs by M. Domeyko was read. They related to the composition of the aerolites found in the desert of Atacama, and to several new minerals found in Chili. The aerolites of Atacama consist invariably of nickeliferous iron with an admixture of olivine. Among the new Chilian minerals some are of great interest. There is one an *oxy-chloroiodide of lead* which forms an amorphous crust upon galena. It has the composition—

Oxide of lead	47·1
Chloride ,, ...	22·8
Iodide ,, ...	18·7
Various matters	9·5
	98·1

which may be represented by the formula—

$$2Pb(Cl_2I)_3PbO.$$

The industrial importance of a mineral containing 10 per cent. of iodine is great, if the quantity obtainable be considerable. The author also found two new amalgams—Ag_6H, and Ag_5H_3.

A note by Signor Bechi on the *Boraciferous Soffioni* of Tuscany makes known the existence of a new mineral, to which the author has given the name of *Boussingaultite*. It consists of a hydrated sulphate of ammonia, in which part of the base is replaced by magnesia and protoxide of iron.

M. J. A. Poumarede sent a communication in which he proposes to use the vapour of zinc as a reducing agent in some metallurgical operations. Chlorides and fluorides, for example, can be easily reduced by this process. The apparatus consists of two crucibles, one resting within the other, into the lower of which the zinc is placed, while the other contains the metallic compound to be reduced. The two are arranged so that the vapour of zinc is brought in contact with the metallic compound. In this way the author has obtained beautiful specimens of crystallised iron, cobalt, and nickel.

CHEMICAL SOCIETY OF PARIS.

February 26.

M. Ad. Wurtz *in the Chair.*

M. **Paul Devissne** was elected resident member.

M. **Bonis** presented to the Society, on behalf of M. Jacquelain, a small work, entitled "*General Method for the Analysis of Fresh Water.*"

M. **Wurtz** gave an account of his researches on allyle. When this compound is heated with idriodic acid it combines either with one molecule of this acid to form a monohydriodate $\mathrm{C}_6\mathrm{H}_{10}$,HI, boiling at about 166°, or with two molecules of idriodic acid to form a di-hydriodate of diallyle

$$\mathrm{C}_6\mathrm{H}_{10}\left\{\begin{matrix}\mathrm{H}_2\\ \mathrm{I}_2\end{matrix}\right.$$

which is not volatile without decomposition. M. Wurtz has obtained acetates and hydrates corresponding with these hydriodates. He described the composition and the properties of these bodies, and in particular of the dihydrate of di-allyle

$$\mathrm{C}_6\mathrm{H}_{10}\left\{\begin{matrix}\mathrm{H}_2\\ (\mathrm{HO})_2\end{matrix}\right.$$

which is identical or isomeric with hexylglycol $\mathrm{C}_6\mathrm{H}_{14}\mathrm{O}_2$. He added that in these experiments allyle behaved like a hydro-carbon of the series $\mathrm{C}_n\mathrm{H}_{2n-2}$. He had also satisfied himself that allyline combined in a similar manner with idriodic acid.

M. **Wurtz** presented a paper by M. Hugo Müller, "*On the Synthesis of Malonic and Succinic Acids.*"

M. **Oppenheim** remarked that the formation of hydriodate of phosphuretted hydrogen, which he had already laid before the Society, would admit of two interpretations. He did not admit the decomposition of water.

This communication gave rise to a discussion, in which MM. Oppenheim, Berthelot, and Personne took part.

PHOTOGRAPHIC SOCIETY.

Tuesday, April 5, 1864.

After the Minutes of last meeting were read and confirmed,

Mr. **Brothers**, of Manchester, exhibited a series of pictures taken by means of the magnesium light.

A portrait in enamel of the Lord Chief Baron was exhibited by Mayall.

Some transparencies on opal glass were also exhibited; also, some photographs by Cooper's method, and a picture on which the opinion of the Society was requested as to whether it was a photograph or not.

Mr. **Swan** then read a paper "*On the Improved Method of Carbon Printing.*" He first pointed out the defects of the silver process, the great fault being liability to fade; this, in fact, was the great blot on the fame of the art. In quest of processes by which permanent pictures could be produced, carbon was naturally thought of, and many attempts had been made, with more or less success, to employ this substance for the purpose; but there were objections to the processes proposed—either they were not perfect, or too troublesome to be practically employed. Mr. Swan, however, had been able to surmount the difficulties and to produce good results. The principal improvement consisted in the employment of a tissue which was transparent and pliable to replace the paper ordinarily employed. The manner in which this tissue is prepared is as follows:—Pour some collodion over a glass plate, and let it dry; then pour over the film of collodion a warm solution composed of the following ingredients: one part of bichromate solution (containing one of salt to three of water), two parts of gelatine, one part of sugar, and eight parts of water. To this mixture is added colouring matter, composed of Indian ink, to which may be added indigo and carmine. The tissue, after drying, is removed from the glass and placed under the negative, so that the light passes through the collodion film, and reaches first the inner side of the gelatinous film. This is altered by the light in such a manner as to become insoluble in water, and it is important to notice that the interior part is first acted on, so that in those parts of the picture where half tints occur there will be a thin layer resting on the collodion rendered insoluble, while that remaining unacted on will be exposed so as to be easily removed. In the old methods of applying this process the outer surface of the gelatinous layer was first thickened, and in consequence preserved a layer beneath, which could not be reached by the solvent without breaking the film, so that the half tints either remained dark, or, the coating being entirely removed through fracture, they became like high lights. In the new method the thickness of coagulated coating is exactly proportioned to the depth of colour. After exposure under the negative, which only requires a third or fourth of the time necessary for paper prepared with silver in the ordinary manner, the film is fastened to a sheet of paper by means of starch or a solution of india-rubber, and placed in water at 100° F. A few minutes suffice for the purpose, but it is better to allow the picture to remain three or four hours in the bath, brush it lightly with a camel's hair brush to remove any adhering pigment, and then expose to a stream of water, allow to dry, and mount. With reference to the time of exposure, it was to be remarked that a little variation in this respect was not nearly so important as with silver prints, and over exposure could be remedied by long washing with hot water; but Mr. Swan thought it would be very advantageous to have some better means of regulating the time of exposure than that at present employed, and suggested the use of a photometer for the purpose. In order to avoid the inversion of the image, the print might be mounted face downwards, and the supporting paper afterwards removed by benzol; or the reversal could be avoided by removing the negative from the glass before printing by means of gelatine. With respect to the colouring matter, various substances had been tried. Carbon produced by the action of sulphuric acid on sugar had been proposed, but found to be too flaky, and the same objection applied to lamp black, but various colours might be employed. Mr. Swan expressed his conviction that the process was practically applicable on a large scale. With respect to the patenting of the process, he had at first thought of putting no restriction on its application, but it afterwards occurred to him that, since it would probably be employed commercially, it would be desirable to participate in the profits accruing from its adoption, but he did not wish to prevent its employment for any scientific purpose.

The **Chairman** remarked on the perfection of the prints, and returned thanks to Mr. Swan in the name of the Society.

In answer to a question by a Member as to what part of this process was claimed as original, Mr. **Swan** replied that the tissue was the principal novelty, its transparency being such that the light passed through it without serious diminution, and, consequently, the printing could be performed by allowing the light to traverse the collodion film, and reach first the interior of the gelatine film. The Chairman drew attention to the results obtained, which certainly surpassed any previously laid before the Society.

In reply to various other inquiries, it was stated that the application of the process to engraving was still under consideration, but that there was every promise of success, that the object of the collodion film in the tissue was to hold the picture together, for otherwise it would fall to pieces in washing; that the short time of exposure necessary in printing might be due to the presence of sugar, but experiments had not been made on this particular point; and that a better print could be obtained from imperfect negatives than by the silver process.

Dr. Diamond, of Edinburgh, remarked on the applicability of the process to enamel painting, since any pigments could be mixed with the gelatinous coat.

Mr. How exhibited a photographer's tent, of which the chief recommendations were its compactness, lightness, and the arrangements of its fittings, all of which were exterior.

Royal Institution.—Tuesday, April 12, at three, Professor Helmholtz, "On Conservation of Energy." Thursday, April 14, at three, Professor Helmholtz, "On Conservation of Energy." Friday, April 15, at eight, Professor Abel, "On Gun-cotton." Saturday, April 16, at three, Prof. Frankland, "On the Metallic Elements."

Respiration of Fruits.—M. Cahours has made an examination of the respiration of fruits; he considers that the fruit is one of the most important organs of vegetables, and that the examination of respiration should be by no means confined to the green part of the plant. He has endeavoured to study the proportion of gases contained in the parenchyma of the pericarp and their composition; the action of fruit upon the gas of respiration, *i.e.*, oxygen, whether alone or mixed with nitrogen; the action upon the same gas of each of the envelopes of the fruit and of its fleshy part when it exists. It was found that apples, oranges, citrons, in a state of maturity, placed under bell jars containing oxygen, or mixtures of oxygen with nitrogen, consumed a quantity of oxygen, and furnished an equal amount of carbonic acid, the proportion being greater in diffuse light than in darkness. It is effected gradually up to a certain point, beyond which it augments considerably, and the internal face of the skin presents some alteration. The amount of carbonic acid produced increases with the temperature. The fruit acts in the same manner during the time elapsing between its losing its green colour and its obtaining its maturity, and that of its obtaining its maturity and of its commencement of decay; but as soon as this has once commenced the amount increases rapidly. Determinations were made of the proportions of gases contained in the juices. To accomplish this, the fruit was squeezed under mercury, and the juice collected in a flask, to which was afterwards adapted a tube by a cork, but it was found that the same result was obtained if the juices were expressed in an ordinary press and afterwards placed in vessels. The gases were expelled by ebullition. Oranges, citrons, pomgranates, pears, and pippins gave quantities of gas diminishing in in the order of the names; the gas consisted of carbonic acid and nitrogen in various proportions, but no oxygen, hydrogen, carbonic oxide, or carburetted hydrogen was found. A ripe fruit enclosed in air was found to absorb hydrogen very rapidly, and if allowed to remain until it became soft, the juice was found to contain a very large quantity of gas rich in carbonic acid, the air in which it was enclosed containing carbonic acid also. It is intended to examine the gases contained in the juice from the commencement of development to the time when it has attained its complete maturity.

NOTICES OF BOOKS.

The Industrial Resources of the District of the Three Northern Rivers, the Tyne, Wear, and Tees; including the Reports on the Local Manufactures, read before the British Association in 1863. Edited by Sir W. G. Armstrong, C.B., F.R.S., &c. &c., J. Lowthian Bell, Esq., John Taylor, Esq., and Dr. Richardson. Illustrated with Maps, Plans, &c., &c. Newcastle-on-Tyne: A. Reid. London: Longman and Co. 1864.

The meeting at Newcastle will long be remembered as one of the most successful gatherings of the British Association; and it will not be forgotten how great an interest was given to the proceedings by the valuable papers on the local industries now collected in this volume, and here illustrated by maps, plans, and engravings, with a profuseness we have never seen equalled. The volume as it lies before us may be taken as a pattern of what we could wish to see done for every similar district in the United Kingdom.

A complete account of the industrial resources of the Kingdom has yet to be written; but to compile and digest it would be beyond the labour of even a Macculloch. The work could only be produced by the co-operation of several heads and hands, as in the present instance; and, in the absence of the complete work so much to be desired, we hope to see the visit of the British Association to every centre of industry result in the production of such a local record.

Abstracts of many of the papers contained in the volume appeared in our pages shortly after the meeting, and we need not again refer to them. But the illustrative maps and engravings scattered so profusely through the pages of this volume give it a lasting and peculiar interest which the mere papers, valuable as they were, could not possess.

Appendices have been added to the papers which give manufacturing details it would have been impossible to supply in their original form. We turn, for example, to the paper on the Chemical Manufactures of the Tyne, which our readers will find at page 124, vol. viii. of the Chemical News. In that paper some of the most recent improvements in the manufacture of soda were attended to, particularly the revolving furnace of the Jarrow Works, and the method of condensing hydrochloric acid adopted so successfully at the Walker Alkali Works. Now, among the appendices to the paper included in this volume, we find descriptions and drawings of both these improvements, which may be of great service to manufacturers. Besides this, these additions to all the reports will be found to contain much original matter, published for the first time, and sometimes drawn from out-of-the-way sources. There is, for example, an interesting account of jet, from which we extract the first sentence:—"This material takes its name from a river in Lycia, which was called Gages in the time of Pliny, and the small pieces of jet obtained in that locality were called *gagates*, afterwards corrupted into *gagat*, and ultimately into *jet*." We shall not dispute this etymology, the authority for which is not quoted, but we always supposed that *gagates* were agates.

Some curious information will also be found in the reports on the manufacture of paper and of glass. But the more solid information is not wanting, and we heartily recommend the book to our readers, at the same time thanking the authors and the Newcastle publisher for the richness and excellence of the illustrations, which must have been produced at a very considerable cost.

British Pharmacopœia.—The cheaper edition of the Pharmacopœia is now announced as ready. Owing to a press of matter, we are compelled to postpone our notices, which will be resumed in our next number.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

280. John Hawkins, Walsall, Staffordshire, and Charles Hawkins, Selly Oak, Worcestershire, "Improvements in the manufacture of gas for illumination and other purposes, and in apparatus connected with the same."—Petition recorded February 2, 1864.

399. Frederick Charles Phillip Hofmann, Wilmington-square, London, "Improvements in machines for crushing hard substances, for washing ores and minerals, and for separating earth and earthy matters from solid substances."—Petition recorded February 16, 1864.

408. Henri Newmane, Hortulau Villas, Shrewsbury, Shropshire, "A new medicinal compound pill for diseases of the liver."—Petitions recorded February 17, 1864.

418. Laurent Stanislas Naudin, Rue de la Savonnerie, Rouen, France, "Improvements in the preparation and composition of a substance for soldering silver or other metals."

419. John Travis, Luzley Brook, Royton, Lancashire, "An improved method of preventing and curing corrosion and preserving the metal in steam boilers, steam generators, and fuel economisers."

424. François Marie Aubert de Tregomain, Stamford Street, Surrey, "Improvements in rendering firewood and other materials more combustible, and also impervious to air and moisture."

431. John James Chidley, Glaskin Street, Hackney, London, "An improved method of stoppering or rendering air-tight bottles and jars."

432. Frederic John Arnold, Adam's Court, Old Broad Street, London, "Improvements in apparatus for producing and burning combustible gases for heating and lighting purposes." — A communication from Thomas Arnold, New York, U.S.

435. Robert Scrivener, Hanley, Staffordshire, "Improvements in the preparation of clay and other plastic materials used for manufacturing purposes, and in drying materials manufactured from the same."

436. William Charles Page, Millwall, Poplar, Middlesex, "An improved composition for coating ships' bottoms."

446. Alfred Vincent Newton, Chancery Lane, London, "An improvement in photography."—A communication from George Garnier White, New York, and Charles Alden, Newburgh, New York, U.S.

452. John Sanders, jun., Upper Hockley Street, Birmingham, "A new or improved gas regulator for controlling or regulating the flow or pressure of gas required to be used for illuminating purposes."

454. Eugene Alphonse Cotelle, Bouvelart St Martin, Paris, "An apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general."

465. Francis Sorrel Claxton, Imperial Foundry of Cannon, Ruelle, Charente, France, "An improvement in casting iron, brass, or copper over or around hollow cylinders of steel, iron, or other metal, using air, water, or other fluid for cooling the casting."

Notices to Proceed.

2762. William Henry Perkin, Seymour Villa, Sudbury, Middlesex, "Improvements in the manufacture of colouring matters, suitable for dyeing and printing."—Petitions recorded November 6, 1863.

2819. William Edward Gedge, Wellington Street, Strand, London, "Improved process and apparatus for amalgamating the precious metals."—A communication from Jean Baptiste Baux and Alexis Guiod, Passages des Petites Ecuries, Paris.

2866. Gilbert Thonger, Birmingham, "Improved modes of preventing accidents arising from the sale or use of poisons."—Petition recorded November 16, 1863.

3213. William Henry Tooth, Rhodeswell Road, Stepney, Middlesex, "Improvements in the manufacture of iron and steel, and in the machinery, apparatus, and furnaces used therein, and for the production and application of gas to be employed in such manufacture, and the application of parts of the said apparatus to the manufacture of glass and alkali."—Petition recorded December 19, 1863.

3246. James Ronald, Liverpool, "Improvements in, and apparatus for, the conversion of ropes and other cordage into oakum, tow, and paper-stuffs, parts of which are applicable to teasing and cleaning wool, or hair on skins, and dressing 'waste' tow, wool, hair, and other 'waste' fibres."—Petition recorded December 23, 1863.

372. William Drake, Sheffield, Yorkshire, "Improvements in the manufacture of iron."

2696. John Henry Johnson, Lincoln's-inn Fields, London, "Improvements in the manufacture of soap."—A communication from Jean Baptiste Vasseur, and Alexis Mahot, Paris.—Petitions recorded October 30, 1863.

2724. Guillaume Ville, Paris, "Improvements in treating natural phosphates of lime for agricultural purposes."

2803. Dan Dawson, Milnsbridge Chemical Works, Huddersfield, Yorkshire, "Improvements in the production of colours for dyeing.—Petitions recorded November 11, 1863.

3168. Henry Chadwick, Topsham, and John Clench, Exeter, Devonshire, "Improvements in utilising the waste liquors resulting from the preparation of fibrous matters in paper pulp making, and in the machinery or apparatus to be used therein."—Petition recorded December 15, 1863.

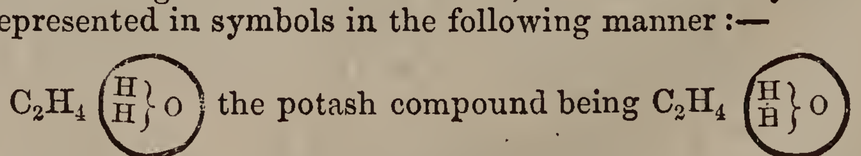
7. Charles Martin, Brentford, Middlesex, "Improvements in the treatment and preparation of materials for the manufacture of paper, and in the construction and apparatus employed therein."—Petition recorded Jan. 2, 1864.

488. William Edward Gedge, Wellington Street, Strand, London, "Improvements in the composition and manufacture of artificial granite, marble, and stone, and in the kilns and apparatus used in such manufacture."—A communication from Jean Begué, Faubourg St. Martin, Paris.—Petition recorded February 27, 1864.

Origin of Species.—A work has just been published by M. Flourens, entitled, "Criticism of the Book of M. Darwin upon the Origin of Species."

Citrate of Iron and Magnesia.—This preparation is made as follows:—The hydrated oxide from three and a-quarter ounces of persulphate of iron is dissolved in three ounces of citric acid, and the solution is then completely saturated with carbonate of magnesia. The solution is afterwards filtered and evaporated to a proper consistence, and scaled in the usual way.—*Neues Repert für Pharmacie*, bd., xii., s. 442.

New Acid Isomeric with Sulphovinic Acid.—Mr. A. B. Northcote has accidentally discovered a new acid isomeric with sulphovinic acid; it was obtained by adding sulphuric acid to an alcoholic solution of potash which had been kept for some years. The potash salt crystallises in long prisms, colourless and transparent. It differs from isethimate ordinary sulphovinate, but may be parathionate. The discoverer thinks it probable that the potash, by its powerful affinity for water, alters the molecular arrangement of the alcohol, the altered body being represented in symbols in the following manner:—



$C_2H_4 \left.\begin{matrix}H\\H\end{matrix}\right\}O$ the potash compound being $C_2H_4 \left.\begin{matrix}H\\H\end{matrix}\right\}O$

This view is supported by the fact that the compound acid is formed without heat, whereas to produce ordinary sulphovinic acid heat is necessary.

CORRESPONDENCE.

Continental Science.

Paris, April 6, 1864.

The disease among silk-worms has raged to such an extent in France that it becomes a matter of great importance to devise some means of preserving the life of the worms for a sufficient length of time for them to form cocoons, and it is also desirable to obtain healthy eggs from other quarters. M. Guérin-Menneville says that great exertions are being made by the Government, and that the Minister of Agriculture has advised the préfets of the silk departments to make experiments on the process of Onesti.

Some eggs have lately been sent to France, overland, from China through the exertions of M. Simon, and have been distributed, some having been reserved for experiments; a fresh importation has also been made from Japan by M. Berlandier, and it is hoped that by these means the condition of the silk-producing departments will be ameliorated.

The causes of these curious epidemics are still shrouded in mystery; they make their appearance surreptitiously, increase until they reach a climax, and then wholly or partially disappear, as if they had become exhausted, and all their energy being consumed, they die a natural death. The silk-worm disease has for fifteen years raged in France, but it is to be hoped that the exertions now being made will lead to the discovery of some remedy. A slight change of climate, produced by a variety of possible causes, might be sufficient either to produce or remove one of these pestilences; and if this is the case, remedial measures are likely to be of little use until the disease itself shows symptoms of decline. Our knowledge on these matters is, however, daily increasing, and the advancement of science may in time put us in possession of the means of combating similar attacks.

An interesting notice concerning the flight of the eagle is inserted in *Poggendorff's Annalen* from Dr. Simmler. An eagle was observed to descend obliquely through a space of 40,000 Swiss feet in six minutes, which gives a velocity of more than thirty metres per second. When it is considered that this is a rate of more than ninety-seven miles an hour, and, in fact, exceeds the greatest speed of an express train, it becomes easily credible that sea birds may be caught by placing a board with a fish upon it in the water behind a boat, the bird darting with such force as to strike its bill right through the board.

A great blessing to mothers, and to children, too, although the latter are generally overlooked in these blessings—it being taken for granted, we must suppose, that the blessing is equal for both—has lately been discovered in the shape of a new cure for whooping-cough. The treatment is not severe, and does not include confinement to the house. Quite the contrary; it consists in going to a gas-works and breathing the vapours which arise from the lime purifiers. The relief is immediate, and two or three visits are sufficient to produce a complete cure.

The theory of Mr. Wheatstone of the acoustic figures produced on plates during vibration has been confirmed by a series of experiments by M. Rudolph Kœnig on plates of copper. He has only a remark on a detail of execution, which is as follows:—"Mr. Wheatstone says that if a given system of nodes could take successively every inclination with reference to a given axis, there would result upon a square plate an indefinite number of figures by a series of continual transformations; but experiment shows the contrary. It appears, then, that those figures alone are possible which are composed of primary vibrations, for which maxima of vibration coincide with the angles of the plate. This is not astonishing; for one always observes maxima of vibration at the two extremities of a free rod."

The question of the index of refraction of metals has been investigated, both theoretically and practically, by M. Quincke. The surfaces of metal employed were thin layers of silver deposited by the method of M. Foucault on a plate of polished glass. It was found that the index of refraction of metals decidedly increases with the angle of incidence.

With reference to an observation in Dr. Tyndall's work on "Heat Considered as a Mode of Motion," that it would be interesting to see whether the balls of rifled guns would not show signs of fusion, M. Schrœder remarks that he once made an experiment bearing on this subject, with the object of ascertaining the changes that zinc underwent when heated to various temperatures. He found that at a temperature above boiling water it became granular, and that if the heat was very gradually increased, the metal would, without losing its form, assume exactly the appearance of zinc that had been melted. By having a ball constructed of zinc, he thinks it would be possible to estimate the amount of heat given out on striking the target. An experiment of this kind might furnish some information, but the determinations of temperature would not be very accurate, and it would probably be possible to discover a more certain way of estimating the heat given out by the concussion; at the same time, the suggestion is useful in the absence of a better measure of temperature under the conditions of the experiment.

The art of photography has recently been applied to a useful purpose—namely, to assist in the investigations of physical geography and geology. The benefit afforded by it to these two sciences will be great, and affords an instance of the influence which arts and sciences have over each other; no single one making an advance without carrying the others with it. In the first beginnings of photography there was but little promise of the perfection to which it would ultimately attain, but it gradually advanced by slow steps to its present state of perfection. The advantages it will confer on the two sciences mentioned are evident; by its means the geographer and geologist will each be able to compare together different parts of the earth's surface, with a view to the prosecution of the study of their respective sciences in a much more efficient manner than could be done by means of mere descriptions, and the labout of producing the representations will be much less than that required for the productions of an artist, and will be more appropriate for the ends to be attained, the rigid accuracy in the smallest details which is to be found in photographs being an important point. A great advantage would be gained if not only the outward forms but also the internal structure of geological objects, such as shells, &c., were recorded by photography. By this means a comparison could be made with much greater facility and with less fatigue than by viewing the objects necessarily in the microscope; the prepared paper replacing the eye in this fatiguing operation.

Photography has already produced its effects in the advancement of other sciences and arts. Astronomy has benefited greatly, and the observations necessary for the prosecution of this science are performed with much greater accuracy by its help. It promises to be of great service in the art of lithography, and although there are many sciences that as yet do not seem to be much affected by its presence, there is no telling what may happen hereafter; for instance, it is quite possible that quantitative analysis may hereafter be accomplished by its assistance. To take an example: there is a method of determining the amount of copper in a solution by diluting it until it has the same colour as a standard solution of known strength. The inaccuracy of this process depends upon the difficulty of determining by means of the eye alone the similarity of colour in the two liquids; but if the comparison were made by means of photography; or, perhaps, in this particular instance, since blue is a colour which would not offer facilities of measurement by photography, photometry could be used instead, great accuracy might, perhaps, be insured. In the case of any other colour but blue, photography might be employed to estimate the depth of colour, but it is not wished that it should be understood to be asserted that these processes are at present applicable to quantitative estimations, but only that they might become so, and might offer advantages of speed, and even accuracy, over the present processes. There are but few chemical substances that cannot be made, under some circumstances, to yield coloured solutions, and this is all that is necessary for the application of the process.

In such a manner as this it is that sciences mutually assist each other, the improvements in one necessitating improvements, and bringing to light and necessitating the removal of imperfections in the other, an incessant but gradual advance being thus made; and this applies equally to all branches of knowledge, so that, step by step, an incessant advance towards perfection is made.

On a Peculiarity Resulting from the Presence of Phosphorus in Iron Wire.

To the Editor of the Chemical News.

Sir,—Upwards of twenty years ago it was stated by Griffin, in his "Chemical Recreations" (Ed. 8, p. 154), that thin iron wire exhibits in burning a green light. This statement is repeated by Professor Galloway in his useful little work on "Chemical Analysis;" iron wire at least is placed in that manual (Ed. 3, p. 209), amongst the substances which impart a green colouration to the blowpipe-flame. It is curious, on the other hand, that neither Berzelius, Plattner, Scheerer, Lenz, Bruno Keel, nor any other of the numerous workers with the blowpipe on the Continent of Europe have ever alluded to this reaction.

Struck by this apparent omission, I have lately examined a considerable number of iron wires by the blowpipe. I find that all the light-coloured and comparatively hard wires exhibit the reaction very distinctly—a bright green flame streaming from the point of the wire during the oxidation and fusion of this, whilst a rapid scintillation or emission of sparks accompanies the phenomenon. The dark and soft wires, on the contrary, fuse much less readily, and do not occasion any colouration of the flame.

On investigating the subject more fully, I have discovered that the green colouration is due to the presence of a minute amount of phosphorus in the hard and light-coloured wires. During the combustion or oxidation of the wire, the phosphorus becomes converted into phosphoric acid, and thus occasions the colouration of the flame.

As iron wire is often employed in blowpipe experiments as a reagent for phosphoric acid in mineral bodies, and as it is also occasionally used in the estimation of phosphorus in cast iron (Regnault, *Chemie*, iii., 127), the publication of this note may not be without its use.

I am, &c., E. J. Chapman.

University College, Toronto, Canada, March 17.

MISCELLANEOUS.

Formation of Cell-Wall.—Vegetable histology attracted of late years considerable notice. Herr Schacht has been examining into the formation of the primordial utricle, with a view to discover what light they might throw upon the formation of the cell-wall. At an early stage in the development of the embryo, numerous currents were observed in the protoplasm, and afterwards a network of threads of cellulose, corresponding to these currents, are found, resulting from the gradual change of the protoplasm itself; these continue to increase in thickness. This formation is considered analogous to that of the outer layer of the primordial utricle from the inner layer of the same; the various modifications are also explained by the supposition of the existence of currents. The gradual formation of cellulose threads in this manner is considered conclusive against the theory that the cellulose wall is a secretion of the primordial utricle.

New Pharmacy Bill.—The following are the heads of a bill now under the consideration of the Council of the Pharmaceutical Society:—

After the 1st of January, 1865, no person to keep open shop for dispensing the prescriptions of duly qualified medical practitioners unless registered as a Pharmaceutical Chemist under the Pharmacy Act, or as a Chemist and Druggist under this Act. Examination established for all who commence business after that date.

Examiners under Pharmacy Act to be the Examiners under this Act.

Registrar under Pharmacy Act to be the Registrar under this Act.

Chemists and Druggists in business in Great Britain before 1st January, 1865, entitled to be registered as Chemists and Druggists, on payment of a fee not exceeding one guinea, and saving to them all their existing rights.

Assistants and Associates under Pharmacy Act, who have passed Minor Examination, to be registered as Chemists and Druggists on commencing business.

Council of Pharmaceutical Society to make orders for regulating Registers to be kept.

Duty of Registrar to make and keep correct Register.

Evidence of Qualification to be given before Registration —of Examination on the part of those who enter business after said date;—of having been in business before said date by others.

Annual Register to be published and be evidence.

Penalty on wilful falsification of Register.

Penalty on obtaining registration by false representations.

Penalty on falsely pretending to be a registered person, or keeping open shop for dispensing said prescriptions, not being registered.

Registered Chemists and Druggists, having passed Minor Examinations, may be elected as, and continue and use title of, Associate of Pharmaceutical Society, and may vote at Meetings of the Society.

Saving of rights of duly qualified medical practitioners.

Benevolent Fund may be applied to past Members and Associates, also to Pharmaceutical Chemists and Registered Chemists and Druggists.

Preservation of Wood.—The following composition is recommended to protect the bottom of posts, palings, and tubs set in the earth:—Forty parts of chalk are added to fifty parts of resin and four parts of linseed oil, melted together in an iron pot. One part of native oxide of copper is then added, and one part of sulphuric acid is cautiously stirred in. The mixture is applied hot with a strong brush, and forms, when dry, a varnish as hard as stone.—*Neues Jahrb. für Pharm.*, bd. xx., s. 235.

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

T. M.—Just above the surface of the fluid.

W. B.—1. Consult the Index at the Patent Office, Chancery Lane. 2. Not that we are aware of.

G. C.—The process is a very old one.

J. F.—Toluidine is now to be obtained at the same price as aniline.

Erratum.—P. 167, col. 2, *for* "Iridium," *read* "Indium."

Received.—H. N. Draper; Gehe and Co.

Books Received.—Haselden's "Notes on the British Pharmacopœia;" "The Ophthalmic Review;" "Proceedings of the American Pharmaceutical Association, 1863."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analysis of the Harlow Car Waters, near Harrogate, by Dr. Sheridan Muspratt, *M.D, F.R.S.E., &c., Founder and Principal of the Liverpool College of Chemistry.*

About a mile and a quarter west of Harrogate springs are situated, which have, recently, been very much resorted to for cutaneous and other affections. A suite of handsome baths have been erected, also an hotel. They are delightfully situated on a gentle slope, and sheltered by surrounding plantations, combining altogether a most salubrious abode for an invalid. The waters of these springs were analysed by the late Mr. West, F.R.S., of Leeds, in the year 1844, but several doubts having arisen regarding his statements, at the suggestion of my friend, Dr. Bennett, of Harrogate, I have subjected furnished samples of the waters to a thorough investigation, and the results arrived at are certainly very different to those already published. Annexed are the tabulated numbers:

	Grains in the Imperial Gallon.	
	No. 1.	No. 2.
Carbonate of lime . .	10·498	10·501
Carbonate of magnesia .	1·002	1·347
Carbonate of soda . .	15·093	15·380
Carbonate of potassa .	traces	traces
Carbonate of iron . .		
Carbonate of manganese .		
Sulphide of sodium . .	2·852	3·543
Sulphate of magnesia .	4·593	3·831
Chloride of magnesium .	5·741	5·194
Chloride of sodium . .	1·006	3·513
Chloride of potassium .	trace	trace
Ammonia	trace	trace
Silica, &c.	0·841	0·706
	41·626	44·015

Mean temperature of the spring 46°.

Mr. West gives only the annexed ingredients in his analysis, *videlicet*, carbonates of lime, magnesia, and soda, sulphate of magnesia, and chloride of calcium. He did not find *sulphide of sodium*. Now, it is upon this compound and the carbonate of soda that the therapeutic effects of the waters chiefly depend.

I have my misgivings as regards the presence of *free* sulphide of hydrogen in the springs. Dr. Bennett, as far back as 1843, wrote as follows:—"I have frequently examined our sulphur springs, both public and private, and I have never been able to detect free sulphide of hydrogen." This view I readily endorse with respect to the Harlow Car waters. They do not contain any of this gas in an uncombined state, and very little free carbonic acid. The waters of Harlow Car, on exposure to the atmosphere for a minute or two, evolve a faint hepatic smell, but this is the result of the decomposition of a metallic sulphide.

My friend, Dr. Hofmann, made a very elaborate and careful investigation of the medicinal waters of Harrogate in the year 1854. He states that the sulphide of hydrogen exists in those waters "partly free, partly in combination with metallic oxides. Only a portion can be expelled by boiling. We have not at present sufficient data to calculate with any degree of certainty the amount of sulphide of hydrogen which is free and that which is combined, and I have, therefore, introduced into the report the whole quantity in the form of sulphide of sodium." It is very dubious to me whether even in the Harrogate springs there is any *free* hydrosulphuric acid. Further researches may be able to settle this moot-point.

College of Chemistry, Liverpool.

General Theory of the Action of Affinity, by M. E. J. Maumene.

When two bodies are placed in presence of each other, and by the exercise of their affinity produce a chemical action, these two bodies obey laws of which hitherto we have no exact knowledge.

When sulphuric acid acts on a metal we see nothing else in general, in their reciprocal action, than SO_3 and M; and on subtracting HO the reaction is represented by the very simple formula—

$$M \div 2SO_3 = MO,SO_3 + SO_2.$$

The most striking result of the reaction is in accordance with this uniformity, but it is not always the only one. With certain metals there is a certain varying quantity of sulphide; with others, a greater or less quantity of sulphur.*

But how to explain this *accident?* We have as yet no precise rule.

If we examine the action of nitric acid on metals, the accident becomes of greater importance. Whilst the concentrated acid gives a nitrate, or metallic acid, and no ammonia, the diluted acid gives more or less considerable quantities of the latter; and this is a serious accident, of which only a *soi-disant* explanation is given. Ammonia can proceed only from water, and water is truly said to determine its formation; but as concentrated acid contains water, why does it not produce ammonia?

I could cite many more instances. These facts may be easily explained; it is sufficient to consider exactly the true circumstances under which affinity is exercised, and then to apply well-known rules.

When we introduce into a retort one equivalent of copper and two equivalents of sulphuric acid, according to the formula given above, is it between these weights of matter that the affinity is exercised? Certainly, if the experiment is prolonged, as long as the disengagement of sulphurous acid (the most evident sign of the chemical action) can continue it is true that the whole of the chemical actions proceed from the two weights of matter; but how many chemical actions will there be? Between what bodies is the affinity exercised?

Between all the simple bodies contained in the vessel, that is to say, Cu,S,O and H, or if it be so desired between Cu,SO_3 and HO.

How is this affinity exercised? By determinable weights of matter, and not at all those with which the retort was charged.

In fact, it is a positive rule that chemical action is exerted only by contact, that is to say, at a distance infinitely small. Hence the action of copper Cu and sulphuric acid SO_3,HO can take place only between the molecules of the two bodies situated at very minute distances from the surface of separation.

Another and not less certain rule is, that all action is equal to the reaction. The action of copper on sulphuric acid is thus equal to the reaction of sulphuric acid on copper; and consequently the infinitely small distance to which the acting molecules of copper and acid extend is exactly the same on each side of the surface which separates them.

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* Ann. de Chimie et de Phys., xviii., 311.

Consequently the chemical action is not exercised by the entire mass of the two bodies in the retort, but by equal and infinitely fine layers of the bodies.

Nothing is easier than to estimate the real weights of the matter between which affinity is exercised, for the weight of the two layers of equal thickness is in proportion to their density. If, then, we call

m the weight of metal of which the density is d,
a the weight of acid of which the density is d',

we get the proportion—

$$m : a :: d : d'.$$

On applying this formula we arrive at the clearest evidence as to the cause of the principal phenomena in our experiments, and of the other phenomena considered as accidents.

For instance, take sulphuric acid and lead, and we have—

$$m : a :: 11{\cdot}35 : 1{\cdot}85.$$

Choosing for m the equivalent of lead $103{\cdot}5$ (M. Dumas), and we shall find for a the real number of the equivalents of acid acting on this equivalent of lead—

$$103{\cdot}5 : a :: 11{\cdot}35 : 1{\cdot}85,$$

whence—

$$a = 16{\cdot}87,$$

and as—

$$\frac{49}{16{\cdot}87} = 2{\cdot}9 \text{ (}2{\cdot}904\text{ exactly)},$$

the masses of metal and acid between which the chemical action commences are—1 equivalent of Pb and $\frac{1}{2{\cdot}9}$ equivalent of SO_3HO; or, which amounts to the same thing, 29 equivalents of Pb and 10 equivalents of SO_3HO.

We will examine what action ought to take place between the two masses.

Lead can act on sulphur and on oxygen, but not on hydrogen. We shall have, then:—

1. The affinity of lead for oxygen which may effect the decomposition of acid SO_3 and of water HO. This affinity, from which oxide of lead is formed, is favoured by the affinity of this oxide for the surrounding sulphuric acid, and is very powerful.

2. The affinity of lead for sulphur, which is itself very great, and is favoured by the concurrence of the preceding.

If the action of lead on oxygen is subtracted, we shall have—

$$29Pb + 10SO_3,HO = 29PbO + SO + 9S + 10HO.$$

The matters thus produced react almost immediately on the sulphuric acid in which they are immersed, and none of them can be identified.

If the action of the lead on the sulphur predominates, we have this other formula—

$$29Pb + 10SO_3HO = 7{\cdot}25PbS + 2{\cdot}75PbO,SO_3 + 19PbO + 10HO,$$

and this time the sulphide of lead can be secured, as, in spite of its mixture with sulphate, it is sufficiently abundant to be distinguished by its black colour, and its presence can be verified by analysis.

The latter result is furnished by experiment, and it may easily be supposed that the formation of sulphide will continue during the whole of the action of the materials in the retort. In fact, as soon as a certain quantity of acid has been decomposed by the lead, the water abandoned combines with a new equivalent of acid, and when half the acid originally in the retort has been employed, the other half is no longer concentrated acid SO_3HO, but is evidently acid $SO_3 2HO$. Now, for this acid is found the equation—

$$357PbO + 100SO_3HO = 89{\cdot}25PbS + 10{\cdot}75PbO,SO_3 + 257PbO + 200HO.$$

Thus this diluted acid gives proportionally more sulphide.

On taking account of these considerations it becomes evident how easily all the peculiarities occurring during experiments may be represented, and the apparently singular accidents explained. They may not only be explained, but may serve to measure the relation of affinities. Thus the formation of sulphide during the action of sulphuric acid on lead proves that at that temperature and under those conditions the affinity of sulphur overcomes that of oxygen for lead.

At present I give but this one instance; but the explanation is applicable to all similar instances, and will give the clue towards the unravelling a great number of facts as to which we have hitherto been in the dark.—*Les Mondes.*

TECHNICAL CHEMISTRY.

On the Preparation of a Green Colour without Arsenic, by Dr. Elsner.

Having recently had occasion to study a pulverulent green colouring matter which he had been requested to analyse, and which was called *green cinnabar*, the author found that this matter, all shades of which could be obtained, from the lightest to the darkest, contained various proportions of prussian blue and chromium green. This colour, applicable to the manufacture of paper-hangings, will not serve for painting walls containing lime, as its action alters the tint of the prussian blue. Neither will it serve for colouring bonbons or for any other culinary purpose, because, though it contains no arsenic, it is not free from hurtful qualities. The following are the directions for obtaining the different shades:—

Make a solution of yellow chromate of potash and another of yellow prussiate of potash, then mix the two. Dissolve separately in water some acetate of lead and iron, and add this solution to the others. By precipitating the first two solutions by the third a green deposit is obtained, the tint depending on the proportions employed. It is scarcely necessary to say that the larger the quantity of acetate of lead and chromate of potash, the lighter the shade obtained.

Wash the precipitate carefully and dry it with gentle heat.

The necessary acetate of iron may be obtained in various ways, especially by precipitating a solution of acetate of lead by sulphate of iron and filtering the supernatant liquid.—*Moniteur Scientifique*, v. 382. 68.

Formation of Chloro-carbonic Acid.—When a perfectly dry mixture of chlorine and carbonic acid is passed through a porcelain tube filled with pieces of charcoal, and heated to redness, chloro-carbonic acid is formed. (Dr. Schiel, *Zeitschr. für Chem. and Pharm. Heft.*, vii., p. 220.)

The Berlin Professorship.—We have the best authority for stating that the chair recently vacated by the demise of the late Professor Heinrich Rose, has been offered to Professor H. Kopp, of Giessen, who has accepted the same, and will before long enter upon the duties of his new appointment.

Restoration of Violet Colour.—A lady correspondent sends us the following process for restoring the violet colour discharged from silk by acid juice:—"Brush the portion of fabric with tincture of iodine, then after a few seconds well saturate the spot with a solution of hyposulphite of soda, and dry gradually. The colour will be perfectly restored."

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

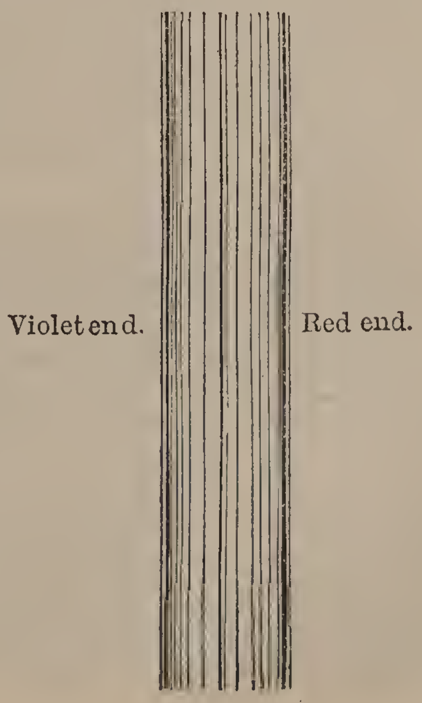
Thursday, April 7, 1864.

Major-General Sabine, *President, in the Chair.*

The first paper was by Dr. Dickinson, "*On the Functions of the Cerebellum*," communicated by Dr. Bence Jones. The writer glanced over the suppositions that have been made at various times as to the functions of this important division of the brain. It has been imagined to be the seat of memory because of its hardness, and from the fact that one is apt to scratch the back of the head when thinking. Some have supposed it to be a second brain, to be the source of involuntary motions, to regulate the motions of the heart and of respiration, a seat of sensation (from the situation of the origin of the fifth cranial nerve), the centre for movements in general, for the functions of reproduction, for co-ordinating bodily movements, for harmonising movements, &c. The author considered none of these functions strictly appropriate to the cerebellum, and has performed a series of experiments with a view to decide this question. The same great divisions of the nervous system can be traced in all the vertebrate animals in which it attains any development, namely, the cerebrum, the cerebellum, and the medulla oblongata and spinal cord. It may be concluded that the functions of each part are to some extent the same in all animals, and in this case a series of experiments on the effects produced by the removal of the different parts would afford data, even if the lower animals were the patients, from which the functions of the same organs in animals higher in the series might be inferred; these latter not admitting of experiments being performed on them, the results being mixed up with the effects of the injury. The course he followed was to remove both cerebrum and cerebellum, leaving only the medulla oblongata, and to compare the effects with those produced by the removal of the cerebellum alone, and of the cerebrum alone. It would take too much space to give a detailed account of all the experiments performed, but it may be stated that with the lower animals, such as reptiles, the effect of a removal of both cerebrum and cerebellum was to take away all voluntary power in the field snake, which remained motionless; the frog performed regular but tardy movements; the salamander was motionless except when irritated; the toad, although it could not walk or swim, tried to turn when laid on its back; the tortoise performed some apparently voluntary motions when irritated, but all movements ceased in twenty-four hours; the eel wriggled, but there were no voluntary movements. When fishes were the objects of the experiments the removal of both cerebrum and cerebellum took away almost all evidence of life, although in some cases respiration and slight convulsions were observed. On submitting the higher animals to a similar mutilation speedy death interfered with observation of the results. The general effects of removal of the cerebellum alone were to produce a loss of activity and of the power of co-ordinating movements, so as to retain the balance, &c., a greater effect being produced on the hind than the fore quarters. A curious stilted motion was observed when the animals walked. The effects of loss of the cerebrum were a loss of vigour, but the animal appeared capable of performing all motions. There were, however, differences according to the place of the animal in the scale of beings. An experiment on the contractile power of the muscles after injury of the cerebellum was tried on the water tortoise. The effect of an injury on one side only was to cause only a slight loss of contractile power, but the opposite limb was always extended. The general result arrived at was that the cerebellum was not concerned in the production of heat, of the secretions, of the motions of copulation, of general motion, or of general sensation. In snakes it appeared that each of the three divisions of the great nervous centre were concerned in the production of motion; in fishes the medulla alone was not sufficient to produce voluntary movements, and in the absence of the cerebellum there was not a proper adjustment of motion; in fishes and reptiles the cerebrum and cerebellum both shared in producing voluntary motions. The fore parts of animals seemed to be dependent more immediately on the cerebrum, the hinder parts on the cerebellum; the cerebellum seemed to regulate habitual movements, and the cerebrum, impulsive movements proceeding more directly from the will. In cases of human beings with congenital absence of cerebellum, there was a want of power of voluntary movement in the muscles of the lower extremity. It would appear that each lobe is in connexion with all four limbs. The author considered that the cerebellum had nothing to do with general sensation, or with any particular sensation. He advanced an hypothesis that, as the cerebellum consisted of two parts, it had two duties, the outer layer being the seat of voluntary motor power, while the inner was concerned in co-ordinating movements.

Professor Sylvester then read a paper entitled, "*An Inquiry into Newton's Rule for the Discovery of Imaginary Roots, together with an Introduction to the Theory of Algebraical Equations with Conjugata Co-efficients.*" He stated that Newton himself had not furnished us with a demonstration of the rule, nor had he left behind him a record that he had succeeded in accomplishing a demonstration, so that its discovery was still desirable. The author did not profess to have furnished a perfectly general demonstration, but only to have made some steps towards it; equations of the fifth degree, however, presented some difficulty. The Professor entered into various questions connected with these equations, such as the curves that they might represent, &c.; but the subject being of such an abstruse nature, he only glanced cursorily over these points.

A communication from Mr. Gassiot, being a description of a train of eleven bisulphide of carbon prisms arranged for spectrum analysis, was then read. The description of the apparatus was one of the points of interest. In its construction many difficulties had to be overcome, one of which arose from the circumstance that the cement employed to fasten the sides of the prisms to the ground-glass bottles forming their body was apt to cause the glass plates forming the sides to warp. To obviate this, a second piece of crown glass was pressed on the surface of each side, a thin layer of castor oil being interposed to prevent reflection from so many surfaces. A great advantage was gained by having these exterior pieces of glass wedge shaped, the wedges being so placed that they acted antagonistically to the bisulphide prisms, thereby diminishing the refraction without materially altering the dispersion. In this manner eleven prisms could be employed without blending the ray to an inconvenient extent, whereas otherwise only seven could have been used. On examining the double line D after passing through this train, it was found that its two components are separated three minutes and six seconds, and that there was a third line exactly equidistant between them, together with other lines filling up the intermediate space as had been before observed, as shown in the accompanying diagram; but the most re-



markable circumstance was that the two dark lines composing the double line were themselves each split up into three lines, the centre one being the thickest. It is intended to examine other parts of the spectrum with this apparatus.

CHEMICAL SOCIETY.

Thursday, March 17, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The Secretary read the minutes of the two preceding meetings (the second being the anniversary on March 30), both of which were confirmed by the Chairman. It was then stated that a resolution of the Council would be proposed at a future meeting, the requisite formal notice of which was now given, to the effect that the following gentlemen be elected Foreign Members of the Society, viz., MM. Dessaignes, Erdmann, and Von Fehling.

The formal admission of Mr. Henry Bassett, Mr. Coleridge Pole, and Mr. C. Greville Williams was declared by the President, after which the members proceeded to ballot for the election of Mr. Wentworth Lascelles Scott, who was unanimously elected a Fellow of the Society.

The Secretary then read a paper "*On Oxyaniline*," by Dr. Schmidt, student in Professor Kolbe's laboratory. The author commenced his researches with nitro-salicylic acid, which was known to form an amido-acid having the formula—

$$HO(C_{12}\left\{\begin{matrix}H_4\\H_2N\end{matrix}\right\}O_2(C_2O_2)O$$

By submitting this amido-salicylic acid to destructive distillation, it was found to split up into carbonic acid and a white crystalline substance for which the name of oxyaniline was proposed. The acid should be mixed with twice its weight of powdered pumice stone before being heated, and however carefully the process was conducted, a small quantity of a fusible brown product was volatilised along with the oxyaniline. This impurity could be removed by digesting with alcohol mixed with a small proportion of acetic acid, wherein it was freely soluble. The equation explanatory of the formation of oxyaniline was thus represented :—

$$\underset{\text{Amido-salicylic acid.}}{HO(C_{12}\left\{\begin{matrix}H_4\\H_2N\end{matrix}\right\}O_2(C_2O_2)O}=\underset{\text{Oxyaniline.}}{\left.\begin{matrix}C_{12}H_5O_2\\H_2\end{matrix}\right\}N}+C_2O_4$$

The properties of oxyaniline were thus described :—The pure sublimed product took the form of definite white needles, which were soluble in water, forming a solution which soon acquired a brown tinge by spontaneous decomposition. This liquid became coloured of a deep indigo on the addition of alkalies, and was again bleached by the action of acids. The aqueous solution had the power of reducing the compounds of the noble metals, becoming, at the same time, changed to a violet liquid. Oxyaniline unites with hydrochloric, hydrobromic, hydriodic, and other acids, forming salts, which, when perfectly neutral, were liable to spontaneous change, but when containing excess of acid were quite permanent.

The President considered these results especially interesting at a time like the present when aniline and aniline compounds were engaging a large share of scientific attention. With reference to the relation subsisting between salicylic acid and the members of the phenyl group, it was remarkably how widely different were the physical properties of the ordinary hydrated oxide of phenyl from coal tar, and that obtained by the action of heat upon salicylic acid. The two bodies were perfectly isomeric, although they exhibited certain differences in their deportment with pentachloride of phosphorus.

Dr. Frankland believed that the new process of Dr. Schmidt would offer an insight into the molecular constitution of this class of bodies. The author had written the formula of oxyaniline on the ammonia type, but the speaker thought it might, with greater propriety, be regarded in the character of a body framed on the pentatype of nitrogen, and similar to the oxide of ethyl-phosphine, when it would be written thus :—

$$\left.\begin{matrix}C_{12}H_5\\H_2\\O_2\end{matrix}\right\}N.$$

The equivalentic value of carbon used by Professor Kolbe and Dr. Schmidt remaining the old number 6. The speaker also suggested that the determination of the monobasic or bibasic character of the body would afford a further clue of great value.

Mr. Henry Bassett was then invited to read a paper "*On the Sub-formiate of Ethyl, and on the Basic Salts of some Organic Acids.*" The author commenced by referring to a preliminary account of the preparation of the subformiate, which had already appeared in the seventh volume of the Chemical News (page 158), and pointed out the advantage of proceeding in the manner then indicated; for by reversing the steps in that process, viz, by adding ethylate of sodium to the chloroform, a considerable loss of product was occasioned by a secondary reaction, in which a copious evolution of carbonic oxide gas occurred. The partial destruction of the compound under these circumstances was thus represented :—

$$2\left.\begin{matrix}CH'''\\(C_2H_5)_3\end{matrix}\right\}O_3+\left.\begin{matrix}C_2H_5\\Na\end{matrix}\right\}O=CO+CHNaO_2+\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$$

$$+3\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O.$$

It would be observed that this equation accounted for the production of ether and alcohol which had been noticed by Messrs. Williamson and Kay when using dry ethylate of sodium in their experiments of 1854. The mode of preparation recommended by the author was very simple, and usually gave a product nearly equal in bulk to the chloroform used. 18 ounces of absolute alcohol were mixed with 3 ounces of chloroform in a flask provided with a long glass tube to serve as a condenser, 1½ ounce of sodium, cut into small pieces, were then gradually added, its action being assisted by a gentle heat in the water bath. The alcohol was then distilled off and the residue dissolved in water, when the supernatant oil, dried over chloride of calcium and rectified, answered perfectly to the pure tribasic formiate of ethyl— $\left.\begin{matrix}CH'''\\(C_2H_5)_3\end{matrix}\right\}O_3.$

The author then proceeded to describe the preparation of the tetrabasic carbonate of ethyl, viz., by gradually adding the proper quantity of sodium to a mixture of chloropicrin and absolute alcohol, the mixture being heated in a water bath, then distilling off the alcohol, and dissolving the residue in water, when the substance in question floated upon the surface of the aqueous solution. The reaction was as follows :—

$$CNO_2Cl_3+4\left.\begin{matrix}C_2H_5\\Na\end{matrix}\right\}O=3NaCl+NaNO_2+\left.\begin{matrix}C''''\\(C_2H_5)_4\end{matrix}\right\}O_4$$

The pure substance boils at 158°-159° C., and has a specific gravity ·925. Two analyses gave results closely agreeing with the theoretical composition, as also did a determination of the vapour density. When boiled with alcoholic potash, the substance deposited a considerable quantity of the alkaline carbonate.

Some of the substance was digested for six hours in the water bath with boric anhydride, and the result distilled; the distillate after purification consisted entirely of ordinary carbonic ether, as was shown by an analysis. The boiling point also was 125°C. This decomposition was thus explained :—

$$\left.\begin{matrix}C''''\\(C_2H_5)_4\end{matrix}\right\}O_4+2B_2O_3=(C_2H_5)_2B_4O_7+(C_2H_5)_2CO_3$$

The author had attempted to produce homologous bodies by the action respectively of the chloride of acetyl (othyl) and the tetrachloride of carbon upon ethylated sodium; but no such substances could be formed. The reaction in the latter case especially was very feeble. Reference was then made to the fact that the addition of water to glacial acetic acid raised the specific gravity. The composition of this acid at its greatest density being $C_2H_4O_2 + H_2O$, seemed to show a tendency to form a triatomic hydrate, which could then be written

$$\left.\begin{array}{c}C_2H_3'''\\H_3\end{array}\right\}O_3$$

The interesting relations existing between the ordinary and the tribasic formic ether and the glycidic ethers and the glycerides were then shown as under:—

$$\left.\begin{array}{c}CH'''\\C_2H_5\end{array}\right\}O_2$$

Formic ether.

$$\left.\begin{array}{c}CH'''\\(C_2H_5)_3\end{array}\right\}O_3$$

Tribasic formic ether.

$$\left.\begin{array}{c}C_3H_5'''\\C_2H_5\end{array}\right\}O_2$$

Glycidic ether.

$$\left.\begin{array}{c}C_3H_5'''\\(C_2H_5)_3\end{array}\right\}O_3$$

Tri-ethylene.

Thus indicating the probable existence of two distinct series of isomeric bodies—one derived from the fatty acids and the other from the triatomic alcohols. The author suggested the possibility of producing the glycidic ethers directly from the glycerides by the action of boric anhydride, and concluded with some general remarks upon the basic salts of certain organic acids.

The President believed he was correct in affirming that there was a discrepancy between the experiences of Mr. Bassett and of Mr. Lockwood, who formerly worked in his own laboratory at University College. Some time had elapsed since the last-named gentleman made the observation that tetrachloride of carbon, as prepared by passing a mixture of chlorine and chloroform vapour through a heated tube, acted very powerfully upon the ethylates of potassium and sodium, and gave rise to a violent evolution of mixed gases, particularly carbonic anhydride and olefiant gas, with a large quantity of ether vapour, were given off, whilst an alkaline chloride was formed. If his memory had not deceived him, the statement of these independent results showed a divergence which was worthy of further investigation. If these observations could be repeated under circumstances so modified that the action should not, on the one hand, be so violent as Mr. Lockwood had represented, nor so feeble or indifferent as Mr. Bassett had just now described, there was a probability of some useful results being obtained.

Mr. Bassett explained that the method which he had followed in the preparation of tetrachloride of carbon was that of exposing chloroform to sunlight for several days in an atmosphere of chlorine gas. The product so obtained had certainly no energetic action upon the alcoholic solution of ethylate of sodium; there was no gas given off, and the only product yielded, whether in sealed tubes or at the boiling point of alcohol, was a brown substance, which resisted the solvent action of all the liquids he had tried, and appeared altogether unpromising in character.

At the conclusion of the ordinary business of the meeting, Mr. Septimus Piesse rose to call the attention of the Society to an announcement which appeared in the *Times* and other newspapers of that day to the effect that a sum of money, amounting to upwards of 100*l.*, had already been subscribed for the purpose of erecting and endowing almshouses in Penzance as a lasting memorial to the great English chemist Sir Humphry Davy. Whether this or other form of recognition,—a statue, for instance,—be ultimately determined upon, the speaker considered it desirable that the Society should take united action in giving support to the movement, and in endeavouring to secure the erection of a worthy monument to so eminent a man.

The President thanked Mr. Piesse for calling the attention of the Society to the subject, and requested him to prepare a formal resolution upon which the Council might take action.

The meeting was then adjourned until the 21st inst., when Mr. J. T. Way will deliver a discourse "*On the Philosophy of British Agriculture.*"

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IX.—*Thursday, January 21, 1864.*

Ladies and Gentlemen,—We now proceed to the consideration of sea water.

The subject of sea water is, indeed, a grand one. We are indebted to Forchammer for some of the best researches —about the most recent as well as the most elaborate. I propose, in the first place, to examine carefully all the elements which have been clearly detected in sea water. No doubt there are many which have eluded our means of analysis. We cannot go beyond a certain point. We have received great aid of late from spectrum analysis, by means of which we are enabled to determine the presence of certain elements by the agency of light. Our senses may afford us evidence of the existence of certain substances, although we may be unable to find them out by our ordinary processes of analysis. Let us take the familiar examples of odours. A small grain of musk may scent a large room, and we know perfectly well that the musk must be there; but although we are sure of its presence, we should be unable to detect the musk by chemical analysis, and thus the power of scent may go far beyond the powers of the greatest chemist in the world.

Twenty-seven distinct elements have been found in sea water.

First of all, there is the water itself. That is composed of oxygen and hydrogen in the proportion of eight parts, by weight, of oxygen to one of hydrogen. Then there is the oxygen dissolved in the water. All water contains oxygen or air dissolved, and the oxygen is dissolved in a greater proportion than the nitrogen of the air. It is this oxygen which is essential to the existence of animal life in the ocean, or in waters generally. Ocean water contains a little organic matter, and of that oxygen is a constituent. We have, then, oxygen as an essential constituent of the water, oxygen dissolved in the water, oxygen as a constituent of the organic matter in the water, and, again, as a constituent of the bases, and of certain acids existing in sea water.

Hydrogen forms one-ninth of the water. It also is a constituent of the organic matter found in the water.

Chlorine forms the largest proportion of the solid ingredients of sea water, existing in combination with various metallic bases, such as calcium, magnesium, and sodium.

Next in order comes bromine, which is also present in sea water, and is, in fact, extracted from sea water. It is obtained from the mother liquor, resulting from the evaporation of sea water and the crystallisation of its salts.

Then comes iodine, which is extracted from sea water, and which can only be derived from sea water. Some years ago elaborate researches were made with regard to the association of the three elements—chlorine, bromine, and iodine—with each other, especially by a chemist of Turin. It was found that they were always in association. Wherever chlorine was, there were traces of bromine and of iodine.

There are two ways in which we can prove the existence of elements in sea water,—first, directly in the water itself by the aid of chemical analysis; and secondly in the plant and animal structures existing in the water, and which can certainly derive their materials only from the water. The one kind of evidence is, I think you will admit, as conclusive as the other. Fluorine is found in the roots of corals. When these are dissolved by hydrochloric acid and precipitated by ammonia, the deposit contains fluoride of calcium—fluor spar, in fact. Forchammer obtained fluorine by the direct evaporation of 100 lbs. of sea water from the Sound of Copenhagen until the common salt obtained began to crystallise. He then added ammonia, digested the precipitate with sal ammoniac, collected the residue, and ignited it. It consisted of phosphate of lime—that is, apatite and fluoride of calcium. You will see one or two curious points in connexion with this presently. It weighed from the 100 lbs. of water as much as 3·1 grains, which is a large amount for the chemist. He easily found fluor spar in the deposit of the boilers of Atlantic steam ships. There is, then, no doubt whatever of the presence of fluorine in sea water.

Sulphur exists in combination with oxygen, forming sulphuric acid. This sulphuric acid is combined with the bases in the water. Sea water, when free from organic matter, may be kept undecomposed in bottles for many years, but when it contains the remains of microscopic animals it undergoes decomposition, and sulphuretted hydrogen is evolved. The sulphuric acid of the salts gets reduced by the presence of organic matter. The largest quantity of sulphuretted hydrogen was found in the water, near the mouth of the river La Plata. The average relation between the chlorine of sea water and the sulphuric acid is as 100 to 11·89. It is very interesting to study the constitution of sea water in this way. I have taken chlorine, the most abundant constituent, as the standard of comparison, and represent it by 100.

Phosphorus is always present, and exists in the state of phosphoric acid. In the evaporated residue washed with water, phosphate of lime is found along with carbonate of lime, fluoride of calcium, sulphate of baryta, sulphate of strontia—that is an interesting point—and silica. There is good reason to believe that there are also borates of lime and magnesia. We shall see the evidence of this directly.

Carbon exists in sea water as free carbonic acid, and as a constituent of the organic matter which may be present, and in very small quantity as combined with lime. Forchammer tells us that all sea water reduces hypermanganate of potash, and therefore contains organic matter, the reduction being effected by means of such matter.

Nitrogen is present dissolved in the sea water, and as a constituent of organic matter. So far as I know, it has not yet been found to exist there in the state of ammonia.

Silicon is present as silica. It exists in the washed residue after evaporation. If you evaporate sea water to dryness, wash it with water, and then treat it with hydrochloric acid, you get a residue containing silica. Moreover, it is found in shells and in corals. A large quantity is met with also in certain sponges, and to such an extent in some sponges from the East Indian seas that after the organic matter is burnt off, the form of the sponge is left in a coherent state. This is due chiefly to the presence of silica. You get, in fact, after the burning, a sponge consisting of silica almost entirely, or to a very large extent.

Next comes boron. This element is present in the form of boracic acid combined with bases. Forchammer sought long in vain to find boron directly in sea-water, while there was certain proof of its being there. It has been found as boracic acid in certain deposits which are found in Prussia, and which have clearly resulted from the evaporation of sea-water.

(To be continued.)

PHARMACEUTICAL SOCIETY.

Wednesday, April 6.

Mr. Sandford, *President, in the Chair.*

The subject of percolation may be said to be as completely exhausted as any substance that was ever submitted to the process, and might now be displaced by another topic of more novelty, if not of greater interest. It was, however, again introduced by Professor Redwood, who, in a paper "*On Percolation*," once more went over the history and *rationale* of the process, the arguments for and against its application to the making of tinctures, and the advantages and disadvantages of certain forms of percolators. With all this we may assume that our pharmaceutical readers are well acquainted, but we may give a brief summary of the paper. Introduced into pharmacy between thirty and sixty years ago, the use of percolation has gradually extended, but in no country and at no time has it completely superseded the older and simpler plan of making tinctures by maceration. There is no difference of opinion about the use of it as a means of effecting the complete exhaustion of a material, and it is specially applicable for making concentrated tinctures, like essence of ginger. But no fixed rules can be laid down so as to enable an inexperienced operator to conduct the process successfully, and it becomes dangerous in the hands of a careless or unskilled person. In general, materials to be operated upon require to be in as fine a state of division as is compatible with uninterrupted percolation. It must be remembered that it is not sufficient for the liquid to pass over the surface of the particles of the material. It must permeate their substance by capillary attraction and circulate through the mass, so that the successive particles of liquid may come in contact with the molecules of solid matter, until all the soluble portion has been imparted. In this it differs from maceration, in which process the material may be said to act like a sponge in absorbing the menstruum where it remains quiescent, while in percolation there is a constant change of particles caused by the hydrostatic pressure of the column of liquid. The advantage of the process of percolation is, that by its means the whole of the dissolved portion is recovered, while after maceration a considerable quantity will remain in the mass, even after it has been submitted to great pressure. There are differences of opinion about the best form for a percolator. A few persons prefer a cylindrical, but the general opinion is in favour of the conical form. The objections to a cylindrical percolator are, first, that when the material becomes saturated with the menstruum it is apt to swell and impede percolation; second, that a substance, like opium, containing much soluble matter, becomes reduced in bulk, and, shrinking away from the sides, leaves a channel for the menstruum to pass without permeating the material; and third, that from the disposition of a liquid passing down a cylinder to aggregate towards the centre, there is always left near the bottom a portion of material through which the percolation has been imperfect. All these objections are obviated by the use of a conical percolator. In the first case, when the mass swells it only rises and accommodates itself to the shape of the vessel; in the second, when it contracts it only settles down, and still remains adherent to the sides; and the third objection is of necessity obviated by the shape of the vessel. In the course of his remarks, Dr. Redwood strongly condemned the practice of displacing, or endeavouring to displace, the last portions of spirit by means of water, and showed that, while it was possible to displace water by means of spirit, water added to a spirituous mixture immediately mixed with it. The practice, he said, only resulted in the deterioration of the tincture. Dr. Redwood came lastly to a form of apparatus he has devised for making tinctures by a process which he believes to be an improvement of that of the British Pharmacopœia. This apparatus consists of a cylindrical vessel with a rounded bottom, and furnished with a tap. It holds three-fourths of the menstruum, as directed in the Pharmacopœia, in which the materials to be macerated can be suspended in a flannel bag. This is so far a modification of Dr. Burton's displacement apparatus, and our readers will see that no necessity for agitating the materials exists. When the period for macerating has expired, the fluid may be drawn off, and then a metal cylinder passed down within the flannel bag, so as to enclose the materials, forms a percolator with a flannel bottom through which the remaining fourth of the spirit may be passed. To carry out the last part of the process, it is only necessary to withdraw the metal cylinder from the bag, which can then be placed under the press, and so the whole of the process carried out with the utmost ease.

Mr. Deane, who has given great attention to the process of percolation, then made some remarks, in which he stated that, from his experience, the process was not one which could be safely left to any one to carry out. It required special skill and attention to many particulars. He then alluded to his first experiments with a cylindrical percolator, and the discovery which led him to adopt the conical form, namely, the fact that at the bottom of the cylinder there was always left an angular space through which the menstruum did not pass. Mr. Deane then dwelt on the necessity of a tap or some other contrivance for regulating the flow of the liquid—a point which requires special attention. He recommended that, before packing the materials, they should be wetted with half their weight of the menstruum, so as to drive out the air from the intercellular spaces, and so avoid the formation of channels through the mass in the percolator. In general, he said, it would be that a quantity of menstruum four times the weight of the materials would be sufficient to exhaust them. In some cases five or six times the weight might be required, but in no case less than three times, and therefore the quantity of spirit ordered in the Linamentum Belladonæ, P.B., was not sufficient.

Mr. Hills, in a few words, expressed a strong opinion in favour of maceration as a method of making tinctures.

The meeting then adjourned.

We may here supply an omission from the report of the previous Pharmaceutical meeting, at which Mr. Haselden read a paper on "*Percolation*," and exhibited a new form of percolator intended to carry out the instructions of the British Pharmacopœia. The percolator is made of block-tin, and is furnished with a tap at the bottom, by which the operator is able to macerate as long as required before the fluid is allowed to pass through; it is cylindrical, and furnished with a moveable perforated diaphragm, about two inches from the bottom, resting upon four supports; the ingredients are placed upon this diaphragm, and three-fourths of the spirit poured on as directed; a portion passes through and fills up the space between the bottom of the percolator and the diaphragm, so that the material while macerating is surrounded by the liquid; it can be well stirred during this primary part of the process. At the expiration of forty-eight hours the tap is turned, and the tincture or liquor allowed to pass through into a glass receiver, of almost any size, fitting the tap by means of a shive; that completed, the second perforated diaphragm is placed upon the top of the material, and the remainder of the liquid added. This having ceased to percolate through, the marc, as directed, is taken out, pressed, and the liquor mixed with the other portion, and the quantity of spirit added to make up the full measure of one or two gallons, as the case may be. The quantity of proof spirit lost in making two gallons of compound tincture of cardamoms was only eight ounces, and the colour and taste of the product were excellent.

Two supplementary meetings are announced for the discussion of the Pharmacopœia.

ACADEMY OF SCIENCES.

April 4.

A memoir "*On the Alcoholic Fermentation*," by M. Béchamp, was read. The author remarks that two orders of ferments exist—one soluble, and therefore not organised, of which diastase may be taken as the type, the other organised, and therefore insoluble. The action of the former is invariable and specific; that of the latter, in a chemical point of view, is essentially variable, like that of all organised beings. The so-called fermentation of cane sugar set up by beer yeast is thus explained:—The yeast plant first of all transforms cane sugar into glucose outside itself by means of a product which it contains ready formed in its organism, and which the author calls *zymase;* the plant then absorbs the glucose, digests and assimilates it, grows and multiplies, and finally throws off the used parts of its tissues in the form of the numerous compounds known as the products of fermentation, just as human beings throw out their waste in the form of urea, &c. According to this theory the alcohol, &c., must come from the yeast, and should be obtained from yeast perfectly free from glucose, which the author's experiments prove does in fact furnish alcohol. M. Béchamp found also that the *Mycoderma Aceti* in contact with cane-sugar yielded alcohol, which it is thus seen may be formed without sugar by yeast, and with sugar by another organism similar to yeast. Hence it is clearly impossible at present to express the so-called fermentation changes by an equation. The author considers them as a series of transformations which take place simultaneously or consecutively, and which may some day be individually explained by an equation comparable to that which expresses the change in starch under the influence of diastase.

In a paper "*On the Estimation of Gases in Soft Waters*," M. Robinet makes known the fact that petroleum, oil of lavender, oil of turpentine and benzine are capable of absorbing and holding in solution considerable quantities of air. When boiled in a proper apparatus they did, in fact, disengage the following proportions:—

Petroleum (by volume)	6·8	per cent.
Oil of lavender	6·89	,,
Benzine	14·00	,,
Turpentine	24·18	,,

On exposure to air afterwards, they again absorbed the same proportions. Petroleum and, probably, the analogous oils also dissolve carbonic acid. M. Buignet has determined the elastic force of the vapour of a specimen of petroleum, which he finds to be less than that of water. M. Jodin communicated some "*Researches on the Modifications produced by Inactive Substances on the Rotatory Powers of Sugars*," which seem, indeed, to be considerably modified in some instances by alcohol, and in all by lime. M. Marcé sent an account of some experiments, which prove that *oil of wormwood*, in doses of from 3 to 8 grammes, produces poisonous, but not fatal, effects. Trembling, stupor, and insensibility are produced with epileptic convulsions and stertorous breathing. The experiments throw some light on the nervous symptoms which follow the excessive use of *absinthe*. M. Barral sends to the Academy a note on a *curious form of hailstone* he observed in Paris on the afternoon of Easter Tuesday. The stones were of an absolutely conical form. We were passing through St. Paul's-churchyard about four o'clock on the same afternoon, and observed precisely the same phenomenon. We picked up at least a dozen of perfect cones, some of them three-quarters of an inch high and half an inch broad at the base. This form of hailstone, M. Barral says, has never before been noticed by meteorologists. Among the cones we noticed a few pyramidal stones which have been observed before. M. Barral observed traces of crystallisation in the structure of the stones he saw, and says they were very hard. Those we picked up were quite soft, and looked like moulded snow, and we remarked no trace of crystallisation. How were the cones produced?

MM. Davanne and Girard communicated a note "*On some Theoretical and Practical Researches on the Formation of Positive Photographic Prints.*" We shall give in this place only the authors' explanation of what takes place in the case of albumenised paper on exposure to sun-light and afterwards in the fixing bath. In the first place they believe in the formation of an insoluble argento-organic lake which gives the characteristic red tone. The change of colour which takes place on immersing the print in the fixing bath they say is the consequence of the hydration of the argento-organic compound, and the same change is produced on exposing the proof to steam. Chloride of silver they believe to be completely reduced in the exposure, the chlorine set free combining with the silver of the free nitrate, and so forming successive layers of chloride, the decomposition of which gives the depth to the print. In this way the authors explain the difference between the pictures produced by chloride of silver alone and those in which an excess of nitrate of silver is employed. Some of these views are original, and we shall give the paper at greater length in our photographic department.

M. Hugo Schiff announces the discovery of another "*New Series of Organic Bases.*" They are, in fact, diamides formed by the action of aldehydes on aniline. The author has studied the action of various aldehydes on aniline, and has come to the conclusion that this body will serve to distinguish a true aldehyde in doubtful cases; thus he decides that oil of rue is not an aldehyde, because it does not act on aniline.

M. Chautard has discovered the presence of caproic and several other acids of the series CnHnO$_4$ in the flowers of *Satyrium hircinum.* The acids can be obtained by the simple distillation of the flowers with water. Butyric and valeric acids are present, but caproic predominates.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

March 22, 1864.

E. W. Binney, *Esq., F.R.S., &c., President, in the Chair.*

Professor Roscoe read the following extract from a letter which he had received from Professor Böettger, of Frankfort, respecting the occurrence of the salts of cæsium, rubidium, and thallium together, in the salt obtained by evaporating the mineral water of Nauheim, near Frankfort:—

"The Nauheim salt is a highly valuable substance, as being perhaps the only material from which cæsium can be obtained in quantity. According to my experiments, 1 cwt. of this salt yields 1 lb. of double chloride of cæsium and platinum, containing small quantities of the rubidium and thallium double salt. At my special request the "Kurfürstliche Salzamt" in Nauheim has arranged to sell this evaporated salt, packing included, at the exceedingly low rate of one thaler (3s.) per cwt. In my spectrum investigations I almost invariably employ a flame of hydrogen in place of the common Bunsen's lamp, as by this means I obtain a higher temperature, and the lines appear, therefore, more distinct. The spectrum of the triple platinum-chloride of cæsium, rubidium, and thallium thus obtained exhibits, in the first place, the well-defined emerald green line of thallium, soon afterwards the two brilliant blue cæsium lines appear close together, then the very broad and ill-defined blue bands of rubidium are seen, as well as the two narrow red lines characteristic of this metal.

"I have lately discovered the presence of thallium not only in many other mineral waters, but also in the vegetable kingdom, in very minute, although perceptible quantities. Thus thallium occurs in the ash or the charcoal from wine yeast, in molasses, tobacco, chicory root, &c. If four pounds of any of these substances are taken, a quantity of the double chloride of platinum and thallium is obtained sufficient for many experiments. According to my most recent experiments, thallium occurs in the dust from the pyrites burners as thallium-iron-alum. I have lately prepared this salt directly from the sulphates of thallium and iron; it is the most easily soluble of all the thallium salts; it possesses the pale reddish amethystine colour of ammonia-iron-alum, it crystallises like this salt in large regular octohedra, and contains twenty-four atoms of water. Sulphate of thallium is isomorphous with sulphate of potassium, and the fact of the formation of the above double salt is another proof of the close relationship between thallium and the alkaline metals, independently of the fact that it almost invariably accompanies potassium, and not unfrequently both cæsium and rubidium."

NOTICES OF BOOKS.

Notes on the British Pharmacopœia, &c. By A. F. Haselden, Pharmaceutical Chemist. London: Hardwicke. 1864.

There are many persons who, like the learned President of the College of Physicians, although they may not so indiscreetly confess it, have not been able to make themselves acquainted with all the details of the British Pharmacopœia. To such this little book may be of some use. Tables of the changes and omissions from the last pharmacopœias of the London, Edinburgh, and Dublin colleges are given, and also of the additions made. The author then goes through the preparations and compounds of the Pharmacopœia, giving usually a paraphrase of the directions with some original comments, and whenever necessary calling particular attention to alterations of strength. An extract or two will give our readers the best idea of the contents of the book:—

"*Infusum Sennæ.*—The alteration in this infusion is very important, more especially in respect to the infusions of London and Edinburgh: it contains only half the quantity of senna, and ten grains less ginger than London; it has one-third less senna, and ten grains less ginger than Edinburgh: the proportions are those of Dublin; so that one ounce of this aperient infusion is equal only to half an ounce of London, and two-thirds of an ounce of Edinburgh."

"*Linimentum Cantharidis.*—This is new to the Pharmacopœia. Four ounces of powdered cantharides are to be macerated with two fluid ounces of acetic acid for twenty-four hours, then placed in a percolator, and ether allowed to pass slowly through until ten fluid ounces are obtained. The loss of ether in making small quantities is about one-third. This preparation will produce a perfect blister, and, therefore, must not be used as a liniment, or confused with the Dublin liniment composed of cantharides and olive oil. Liniment of Cantharides does not seem to be the right name."

Journal für Praktische Chemie. No. 6, 1864.

This number of the Journal contains short articles giving the latest experiments of Deville and Troost "*On Vapour Densities at very High Temperatures,*" "*On Anomalous Vapour Densities,*" and "*On the Measurement of High Temperatures.*" The next article contains a hint for the manure manufacturers. A prince who has done some service to science, him of Salm-Horstmar, tried last summer to solve the question, "What is the inorganic material specifically necessary to the formation of the grain in wheat?" Nature, in the prince's experiments, answered lepidolite! The author sowed his seed in a very unpromising soil—namely, roughly-powdered rock crystal which had been carefully purified; and manured the plants with a mixture of the earthy and saline substances usually found in wheat, but only obtained well-formed plants and perfect grains when lepidolite was employed. A paper "*On the Volumetric Estimation of Tannic and Gallic Acids, as well as Iron, Manganese, Indigo, &c.,*" by Moritz Mittenzwey, explains a very simple process and form of apparatus for estimating the above-named substances by observing the amount of oxygen they absorb from the air. We shall give the paper with cuts of the apparatus. Another series of short articles follows, giving the researches of Pasteur and others "*On Putrefaction*," and on "*American Petroleum*. W. Stein describes a new substance which he has found in the lichen *Parmelia Parietina*, and which he has named *Chrysopicrin*. The formula of this body is $C_{30}H_{11}O_8$, the same as that of chrysophanic acid minus an atom of water. Dr. Braun makes a preliminary communication "*On a New Cobalt Compound*," formed by the action of nitrite of potassium on the cobaltocyanide of potassium. The solution of this substance is of an orange-red colour, and possesses an extraordinary colouring power. Winckler has made some experiments with Thompson's process for the separation of cobalt and nickel by boiling a neutral solution of the two metals in hydrochloric acid and chlorides of calcium and ammonium with carbonate of ammonia, whereby the cobalt is precipitated while the nickel remains in solution. The author found the results, though not exact, sufficiently near for practical purposes. Dr. Mulder describes the spectra of phosphorus, sulphur, and selenium; and Professor Kenngott details several analyses of lithionite. Among the Notizen are the results of some experiments made on a dog with sulphate of soda by Professor Seegen, which will have considerable interest to physiological chemists and physicians. The general result of these experiments leads to the conclusion that the administration of sulphate of soda diminishes the elimination of nitrogenised matters from the system. These results agree with those obtained by the author in his experiments with Carlsbad water on human beings. A notice is also given of Professsor Böttger's process for separating cæsium, rubidium, and thallium from Nauheim water. The process is very simple. The raw salt obtained on evaporation is treated with an equal weight of water. After standing some time, the mixture is thrown on a filter. The clear filtrate contains all the above metals; and the residue on the filter may be thrown away. The filtrate is evaporated to about a third, and then set aside for a night in the coolest possible place to crystallise. All the thallium will be found in the crystalline mass obtained, and the mother-liquor will contain the chlorides of rubidium and cæsium. These may be separated by means of chloride of platinum.

A Dictionary of Chemistry, &c. By Henry Watts, B.A., &c., &c. Parts XIII. and XIV. London: Longman and Co. 1864.

The publication of this valuable work proceeds with the greatest regularity, and the quality of the matter is fully maintained. The article on Heat in Part XIV. is another of those elaborate papers which have given an encyclopædic character to the work.

The Ophthalmic Review: a Quarterly Journal of Ophthalmic Surgery and Science. Edited by J. Zachariah Laurence and J. Windsor. No. 1. London: Hardwicke. April, 1864.

It is gratifying to notice the increase of periodicals devoted to the *science* of medicine and surgery. We should be glad to see more. The *Ophthalmic Review* has been really called for by the immense progress made in ophthalmology—now almost a science in itself—and we wish the Journal every success.

Royal Institution.—Tuesday, April 19, at three, Professor Helmholtz, "On Conservation of Energy." Thursday, April 21, at three, Professor Helmholtz, "On Conservation of Energy." Friday, April 22, at eight, Professor Blackie, "On Lycurgus." Saturday, April 23, at three, Professor Frankland, "On the Metallic Elements."

NOTICES OF PATENTS.

2892. *An Improved Process of Engraving.* P. E. Placet, Paris. Dated October 27, 1862.

For the production of engraved plates for copper-plate printing, the patentee proceeds as follows:—A clean glass plate is first coated with a tolerably thick layer of bitumen of Judea, which then receives its photographic impression by exposure to sunlight in juxtaposition with and beneath any suitable negative or design having parts of unequal degrees of transparency. This operation may be conveniently carried out in the ordinary pressure frame employed in the photographic printing processes. The original negative picture being then removed, the bituminous coating on the glass plate is covered with a film of gelatine applied warm and allowed to set; in this state the whole is plunged into a mixture of naphtha and benzol —(many samples of rectified coal naphtha will be found to answer this purpose)—until the compound layer becomes softened, and ultimately detached from the glass plate. Upon examination it will be found that the portions most acted upon by the light, being insoluble, remain firmly attached to the gelatine, whilst the unaffected parts are entirely dissolved, and the intermediate tints are properly represented by gradations. Carefully removing this layer from the hydro-carbon solvents, by the help of a plate of glass, it will, on examination, prove to consist of an embossed surface, those portions showing the boldest relief which have been most deeply penetrated by the rays of light. In order now to obtain the plate engraved in intaglio, a plaster cast is first taken, and these are again copied and multiplied by the electrotype process.

This invention is undoubtedly based upon the prior labours of M. Niepce de St. Victor, who described, more than twenty years ago, the fact of bitumen of Judea becoming hard and insoluble by the action of light. The copper plate was itself coated with the bitumen, and oil of lavender employed as a solvent for the removal of the unaffected portions. The metallic surfaces thus laid bare were then etched by dilute nitric acid.

2904. *Compound or Material for Coating or Covering Metallic and Vegetable Substances to Preserve them from Corrosion or Decay.* C. S. Duncan, Inverness Road, Bayswater. Dated October 28, 1862.

The inventor proposes to incorporate powdered flint, chalk, sulphur, or glass, with four or five times its weight of marine glue, gutta percha, or caoutchouc, for the purpose of manufacturing plastic compounds very suitable for coating the surfaces of wood and metals. It is recommended to apply them warm, and whilst yet soft, to rub over them any one of a great number of pigments or dry mineral powders which are enumerated in the specification, and finally to polish these surfaces, when thoroughly cold and hard, by friction with any suitable polishing material.

The use of flint powder and resins for coating submarine electric cables, and for insulating purposes, has been highly recommended. The quality of the compositions described by the patentee may be varied *ad infinitum* according to the nature of the application; thus, sulphur would not be an appropriate constituent of a compound intended to be used in the protection of metallic surfaces, although it might answer well upon wood.

2906. *Preparing Albumenised Paper for Photographic Purposes.* Thomas Sutton, Jersey. Dated October 28, 1862.

The inventor soaks the paper in a solution of gutta-percha or india-rubber in benzole or other volatile solvent, dries it, and then proceeds to salt and albumenise the same in the usual manner. The proportion of five grains of caoutchouc to one fluid ounce of benzole is recommended.

The advantages claimed by the patentee are closeness of texture, which tends to keep the albumen more upon the surface of the paper, and thus produces finer photographic impressions. It is necessary, of course, to guard against the dingy colour liable to result from the use of inferior samples of gutta-percha or india-rubber, and to be very particular in keeping the sheets well protected from dust, &c., before albumenising, as the surface at this stage very readily attracts these contaminations. The question of permanence is important, and time only will show whether this kind of paper is subject to the formation of a bloom, or to any of those physical changes which are commonly noticed in gutta-percha.

Grants of Provisional Protection for Six Months.

472. Jean François Rivier, Boulevart de Strasbourg, Paris, "An improved system for filtering and purifying liquids with an endless spouting capillary filter."

474. Henry Carter, Camberwell New-road, Surrey, "Improvements in the manufacture of green colouring matters to be used in dying and printing."

476. George Parry, Ebbw Vale Ironworks, Monmouth, "Improvements in the treatment of slag or the cinder of blast furnaces, for the purpose of utilising the same."—Petitions recorded February 25, 1864.

482. Alexander Prince, Trafalgar Square, Charing Cross, London, "Improvements in filtering apparatus."—A communication from François Michel and Almé Pruvot, Paris.

485. Henri Adrien Bonneville, Porchester Terrace, Bayswater, London, "Improvements in the manufacture of artificial marble."—A communication from Joseph Alibert, Marseilles, France.—Petitions recorded February 26, 1864.

490. Frederick Ransome, Ipswich, Suffolk, "Improvements in the manufacture of artificial stone."

496. James Preston Worrall, Ordsall, Lancashire, "An improved method of colouring or staining the cotton or back of "union silk-faced velvets," or other mixed, cut pile, looped, or "raised" fabrics.

498. John Henry Pepper, Boundary-road, St. John's Wood, London, "Improvements in arranging apparatus for representing spectral and other images on the stage."

500. William Edward Gedge, Wellington Street, Strand, London, "A hygienic and inodorous apparatus, applicable to the cradles or cots of children, and to the beds of adult invalids."—A communication from Paul Geofroy-Gomez, Passage des Petites Ecuries, Paris.

505. Samuel Cooper, Openshaw, and John Mayo Worrall, Ordsall, Lancashire, "Certain improvements in the method of dyeing or colouring certain descriptions of woven fabrics."

521. John Peter, Raeburn, Charlesfield, Mid Lothian, N. B., "Improvements in the production of oil or oleaginous or spirituous and gaseous matters, from coal and other mineral substances and vegetable deposits, and in the machinery, apparatus, or means employed therein."

549. Richard Archibald Brooman, Fleet Street, London, "Improvements in manufacturing a green colouring matter."—A communication from Otto Bredt, Barmen, Rhenish Prussia.

583. John Mayo Worrall, Ordsall, Lancashire, "An improvement in the method of dyeing or colouring looped, cut pile, or raised fabrics composed of cotton and silk."

597. John Thomas Way, Leadenhall Street, London, "Improvements in the manufacture of manure from woollen rags, mixed woollen and cotton rags, shoddy, or waste wool."

Notices to Proceed.

2812. Andrew Craig, Rock Ferry, Birkenhead, "Improvements in distilling hydrocarbons, from coal, shale, and other bituminous substances, and in apparatus employed for that purpose."

2852. William Edward Newton, Chancery Lane, London, "Improvements in the treatment or manufacture of wrought and cast iron and steel."—A communication from Marc Antoine Auguste Gaudin, Rue St. Sebastien, Paris.

2886. William Mattieu Williams, Oak Alyn, near Wrexham, Denbigh, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons, or for the manufacture of the said hydrocarbons and coke.

2894. Heinrich Hirzel, Terminus Hotel, London Bridge, Southwark, Surrey, "Improvements in the manufacture of colouring matters suitable for dyeing and printing."—Petitions recorded November 18, 1863.

2947. Thomas Carr, New Ferry, near Birkenhead, Cheshire, "Improvements in machinery for amalgamating or intermixing dry semi-fluids or aqueous materials, and for agitating solids with liquids for combining, dissolving, or washing the same."—Petitions recorded November 23, 1863.

3290. Henry Caunter, Stornoway, Ross, "Improvements in the manufacture of lubricating matter or composition."—Petitions recorded December 29, 1863.

167. Robert Irvine, Magdalen Chemical Works, Musselburg, Thomas Richardson, Newcastle-upon-Tyne, and John James Lundy, Leith, Mid Lothian, N. B., "Improvements in the extraction or manufacture of oils from animal substances."—Petition recorded January 21, 1864.

496. James Preston Worrall, Ordsall, Lancashire, "An improved method of colouring or staining the cotton, or back of "union silk-faced velvets, or other mixed cut pile, looped, or raised fabrics."—Petitions recorded February 29, 1864.

505. Samuel Cooper, Openshaw, and John Mayo Worrall, Ordsall, Lancashire, "Certain improvements in the method of dyeing or colouring certain descriptions of woven fabrics."—Petition recorded March 1, 1864.

583. John Mayo Worrall, Ordsall, Lancashire, "An improvement in the method of dyeing or colouring looped, cut pile, or raised fabrics composed of cotton and silk."—Petition recorded March 9, 1864.

CORRESPONDENCE.

Continental Science.

Paris, April 12, 1864.

M. Le Verrier has given a lecture at the scientific *soirée* of the Sorbonne, which passed off with great *éclat*; but it is remarked that the audience, instead of being made up of the general public, was chiefly composed of well-known *savants*, professors, and students. Thus the object of the *soirées*—namely, the popularisation of science, or the general dissemination of it—is not answered, the public taking little notice of the interesting facts and speculations of science.

An enterprise has lately been set on foot for the manufacture of guano from fishes. The refuse from fisheries has been for some time past employed in this manner; but it is now proposed to organise fisheries for the purpose of manufacturing the article, which possesses several advantages, decomposing neither too quickly nor too slowly, and exhaling no ammonia. I think I have heard that similar projects have already been started in England.

A new ear trumpet for the deaf, a short description of which appears in the *Union Médicale*, has been invented by Dr. Communal. It is said to possess great advantages, rendering the sound clear and distinct, without fatiguing the persons who use it.

M. de Waldee, who has lived for some time among the ruins of Palenqué, situated in a forest filled with venomous reptiles, succeeded in preventing death from bites of these animals by enlarging the wound immediately by a lancet, introducing butter of antimony, applying a ligature tightly above the wound, and taking ten drops of ammonia in a glass of water every quarter of an hour for twelve hours. Four of the Indian workmen employed by him, who did not employ these remedies, died very soon, but himself and servant escaped through the foregoing treatment.

A Spanish photographer has discovered a varnish which gives an astonishing brilliancy to the prints to which it is applied. He keeps his invention secret, but the varnish is believed to consist of albumen. M. R. P. Matthys, however, has produced a similar effect by means of a layer of collodion spread over the finished print. The result is said to be very pleasing.

MM. Plucker and Hittorff have succeeded in producing spectra of two orders of nitrogen, oxygen, phosphorus, sulphur, and selenium. The two orders of spectra are obtained with a Rhumkorff's coil, the gas being placed in a tube at a pressure of a few centimetres. With the spark from a Leyden jar only one spectrum was obtained. The spectrum of less refrangibility is produced by the gas at a comparatively low temperature, and has a yellow colour; that of greater refrangibility, produced by a higher temperature, has a violet colour. A combination of prisms is employed for the production of the spectra. A peculiarity of the less refrangible spectrum of nitrogen is that it is traversed longitudinally by black lines. The more refrangible is composed of brilliant lines on a more or less obscure ground. To produce the sulphur spectra, a few pieces were placed in the tube which was heated. Carbon vapour gave only the less refrangible spectrum. The most complete spectrum was produced by burning cyanogen in oxygen.

Analytical chemistry is often to a great extent at fault when adulterations form the subject of investigation; this is more especially the case with oils. M. Sorchon has determined with great care the indices of refraction of several essential oils with a view to the detection of admixtures. In cases in which the indices of refraction are nearly equal, circular polarisation can generally be employed to distinguish between different oils.

In the *Journal de l'Anatomie et de la Physiologie* for March is an account of the physiological action of aconitine upon man, and a comparison of its properties with those of aconite. A list of general results is given, from which it appears that aconitine is a narcotico-irritant poison; that it is absorbed more rapidly than strychnine by the digestive tube, which accounts for the rapidity of its action; acts on the nervous centres; that the symptoms are observed in the following succession:—Stoppage of respiration, of general sensibility, of reflex sensibility, and of voluntary movements; that the action of the heart is stopped by its action on the substance itself of this organ; that the effects on the peripheral nerves succeed to those on the central organs; that the excitability of the nervous filaments disappears in the peripheral parts before the nervous trunks lose their sensibility. A good diagnosis by which different poisons could be distinguished by the symptoms would be of great value to medicine; it would also be advantageous to have general systems of treatment for different poisons, which should be divided into classes; much has been already done in this respect, but there is still room for further investigation. There is also an article on the various modes of formation of organised matter in general, and of anatomical elements in particular. The highly-interesting subject of histology is making rapid advances, although it is comparatively but recently that it has attracted the attention of investigators.

Constant Voltaic Battery.

To the Editor of the Chemical News.

Sir,—I shall feel obliged to any of your readers who will give me some information concerning a modification of the voltaic battery which has recently been introduced in conjunction with a small electro-magnetic apparatus, as a substitute for the ordinary domestic bell. The battery is a single-fluid one, consisting of a zinc and carbon element, immersed in a transparent, colourless liquid, but at the bottom of the jar is a pulverulent solid substance. The batteries are of French construction, and I am informed that the alarums they are used to bring into action have almost superseded the usual system of bell-hanging in the clubs and hotels of Paris. It is said that one of these cells will remain in action and perform its duty without any attention for more than a year, and I have had one under my own observation for three months which works as well now as it did at first.

Analysis of the solid substance contained in the cell showed it to be simply persulphate of mercury.

I presume the action of this salt to be as follows:—The powder is supplied dry in the cell, and the purchaser fills up the jar with water. Part of the persulphate is thus decomposed into an acid salt, which dissolves, and a basic salt, which remains insoluble. When contact between the poles of the battery is established, the acid salt is in its turn decomposed into sulphuric acid, which unites with the zinc, and metallic mercury, which precipitates on the same metal, and preserves it from local action. As the acid salt becomes thus exhausted, a new portion of the solid persulphate is decomposed, and thus the action is maintained, terminating only when metallic mercury and sulphate of zinc have replaced all the metallic zinc and sulphate of mercury.

In the belief that this view was correct, I constructed a battery on the plan described, and excited it with persulphate of mercury; I find it works very well for some time, but there is from the first considerable local action—the zinc is rapidly dissolved, and at the end of three weeks or a month all electrical action ceases, evidently from the fluid becoming saturated with sulphate of zinc.

Can any of your readers either refer me to a description of this battery, or inform me how it is that the French one retains unimpaired action for so long a time, and whether I have misapprehended any essential point in its construction or in the composition of the exciting substance?

I am, &c. Harry H. Draper.

Dublin, April 5.

Radicle v. *Radical.*

To the Editor of the Chemical News.

Sir,—I regret to see that you advocate the use of the word "radical" instead of "radicle." Now it seems to me, with the most humble submission, however, to editorial authority, that "radicle" is the proper word. My reason for this view is that "radicle" is a substantive form derived from *radiculus*, whereas the last syllable of the word "radical" shows its adjective origin. Another reason might be shown in the fact that the etymological and chemical meaning of the word radicle are identical. The common sense of the matter seems to indicate that we call cyanogen a "radicle," because it is the "little root" from which the cyanogen compounds proceed, and not because cyanogen is "rooted" or "inbred."

The English substantive form "radical," from "*radicalis*," is, it is true, used to express a person afflicted with that dread political disorder "*morbus Brightii*," but this, I conceive, is because such an individual is anxious to make "radical" changes in existing institutions, and not because he is a "little root," unless, indeed, it be of a large amount of evil for the community generally.

In treating of English etymology I am aware that analogy goes but a very little way; the process by which the word "principal" became a noun may, however, be brought forward with good effect. "Principle," we all know the meaning of; "principal" used as an adjective is also plain; but "principal" used as a substantive, as in "principal" of a college, has evidently originated from the adjective through the gradual elimination of the word "master" or "professor." The use, therefore, of "radical" in chemistry ought to point to the ellipsis of some substantive formerly joined to it, which I do not think has ever been the case.

I believe it is usual when a presumptuous correspondent dares to differ from an editor always to "appeal to the sense of justice so often displayed in his valuable journal," and threaten to send a copy of the letter to some rival organ, both of which salutary customs I beg to comply with. I am, &c. C. W. Q.

Gas Explosion at Utrecht.

To the Editor of the Chemical News.

Sir,—I observe in your valuable periodical that a singular dispute is carried on between Professor Mulder, of Utrecht University, and several other chemists, as to the danger of using, in the manufacture of gas, coals damaged by sea water. Soon after the accident alluded to, I minutely examined the works, and, as a matter of course, my conversation with the manager turned to the cause of the explosion. Without desiring to speak in the least in a disparaging manner about Professor Mulder, I think the cause of the explosion can be accounted for in a far more simple and plausible manner than by coming to a rather so-far sought cause as Mulder does. I will first detail the particulars which I learned while at Utrecht, and then discuss in how far Mulder's theory can be of any avail in this instance. The gasworks were started in September, 1862, but there was a defect in the tanks of the gasholders, which prevented the latter being employed to their full capacity. In consequence hereof the manager experienced, during the long winter nights, considerable difficulty in keeping up the supply of gas; and this difficulty was overcome by increasing, during the first hours of the evening, the number of working retorts. At the latter end of December, 1862, it appears the manager was absent from the works for a couple of days, and as far as I understood he was absent on the night when the explosion took place. The explosion was not exactly in or about the purifiers (dry lime), but proceeded from the purifier house, and the manner in which gas escaped is simply enough accounted for. It is in the first place more than probable that the workmen had packed the lime in too moist a state* on the perforated frames or grates of the purifiers, and had not also, as it would appear, taken sufficient care that the water in the brim of the purifiers was sufficiently filled to prevent an escape of gas after the lowering of the purifier cover. But moreover, it appears that more gas was passed or forced through the purifiers than they were intended to carry in a given time; hence over-pressure and the gas not being able to make its way through the lime, blew off what water yet remained between the purifier cover and the external and internal brim of the former, and found its way in the house where there was no sufficient ventilation, and unfortunately not far distant a gas-flame unprotected by wire gauze, and thus the explosion—the gas being, of course, mixed with air—took place, seriously injuring the building, and, if I recollect aright, also damaging one of the purifier covers. The cause of the escape of gas is by no means a complicate cause at all, as Mulder would make it, and it is very questionable whether the reason assigned by him is at all likely to cause the result he would make us believe it had. Granting for the moment that hydrochloric acid† is evolved along with gas, if coals injured by sea-water are used in its manufacture, then it must not be lost sight of that, first, ammonia is also a product of the distillation of coal; and, second, that the gas previous to entering the purifiers at the Utrecht gas-works passes through a system of pipes for condensing tar, then enters a washing vessel, and next a scrubber filled with coke and where the gas is made to meet with a stream of cold water which falls upon the coke, the gas entering from the bottom and proceeding towards the top of the scrubber. Only after this the gas enters the purifiers, and considering the solubility of hydrochloric acid in water—the presence of ammonia and other volatile alkaline products of the distillation of the coal, it is not only very unlikely, but almost impossible, that any hydrochloric acid should have been left to enter the purifiers; and even if there were some, it cannot but be a minute trace, and that while being absorbed by the lime in the purifiers will not possibly be able to form chloride of calcium to such an extent as to choke the pipes leading to and from the purifiers. I am, &c.,

Dr. A. Adriani.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday next at eight o'clock, when the following paper will be read:—"Philosophy of British Agriculture." By Mr. J. T. Way.

New Work on Blow-pipe Analysis.—As everything relating to the progress of science in our dependencies is of interest in the mother country, we are happy to announce that a work on blow-pipe analysis, which will contain a good deal of new matter, is in course of preparation by Mr. Chapman, of University College, Toronto, Canada.

Experiments on Respiration of Plants, &c.—At the last meeting of the Munich Academy of Sciences, Baron Liebig presented an interesting paper on certain experiments he had made with an apparatus constructed at the expense of the King of Bavaria for estimating oxygen in various bodies. These experiments prove that not only is oxygen disengaged from the atmosphere by plants, but also, and in considerable quantities, by the decomposition of water in the bodies of carnivorous animals. Baron Liebig is of opinion that this fact will throw new light on the phenomena, still so little understood, of nutrition and digestion.—*Moniteur Scientifique*, v. 881, 63.

Nature Printing from Steel.—Mr. Sorby, F.R.S., of Sheffield, describes a new process for printing the texture of "blister" steel, in a letter to the *Quarterly Journal of Science*. He says:—"When iron is converted into steel by cementation, three distinct crystalline compounds are formed, two of which are readily dissolved by diluted nitric acid, whereas one is scarcely at all affected by it. If, therefore, a piece of such steel be ground flat and polished, and then placed in the acid, after a suitable amount of action, this constituent retains its original surface and polish, whereas the other two are so much dissolved that it stands up in sufficient relief to allow of the blocks being used for surface printing instead of a woodcut, to exhibit the structure of different varieties of steel." [The letter is illustrated with a small imprint thus produced.]

ANSWERS TO CORRESPONDENTS.

A Subscriber.—No.

Reader.—1. Not at all likely to succeed. 2. See p. 48 of Dr. Hofmann's "Exhibition Report."

R. S. and A. B.—1. The "Examples of Qualitative Analysis" can be obtained from the College, Cirencester. 2. The price of the chart is 2s. 3. The publication of the Cantor lectures will be commenced when all have been delivered.

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* The lime used in the so-called dry lime purifiers is slaked lime moistened with a sufficient quantity of water to be perceptibly humid, but still able to be passed through a not too small meshed riddle. The chemical action which commences after the gas passes through causes the lime to swell and to harden considerably; so that if care is not taken to place the lime lightly on the grates, it may happen that either the passage of the gas through the lime is stopped altogether, or, at least, rendered very difficult, thereby increasing the pressure, which it is just intended to avoid by the use of dry lime purifiers.

† When a quantity of salt is thrown in a blazing coal fire, or on the burning coals of a steam-boiler furnace, the smoke accompanying the combustion under ordinary circumstances is quelled, but hydrochloric acid escapes from the chimney. I do not see how in gas retorts chlorine could be evolved unless in combination with hydrogen.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Assay of Tin Ores, by Clemens Winkler.*

The author mentions the well-known difficulty of obtaining all the tin in one button in a dry assay by the ordinary process, and the error of 5 or 10 per cent. which arises. To avoid this loss, he suggests the addition of copper for the purpose of collecting together the tin, and states that he has obtained tolerably accurate results by the following process:—

The ore is finely pulverised and roasted, first by itself and then once or twice with charcoal or coke, to remove sulphur, arsenic, and antimony. The residue is then digested for a quarter or half an hour with hot hydrochloric acid, and afterwards well washed with hot water. Iron, manganese, and copper, he states, are more completely removed by fusion with bisulphate of potash, and then treating with hydrochloric acid, and washing with water. Tungstic acid, if present, will now be removed by digesting with caustic potash or ammonia.

The oxide of tin, silica, &c., remaining is now mixed in a crucible with an equal weight of peroxide of copper, and two or three parts of flux, consisting of two parts anhydrous carbonate of soda, one part white flour, and a quarter part borax glass. The whole is then covered with a layer of common salt, upon which a piece of charcoal is laid. The crucible is then heated first to a red and then to a dull white heat for an hour, after which a button containing the whole of the tin and copper reduced will be found at the bottom.

As pure peroxide of copper may not be obtainable, the author recommends that a portion of every sample should be separately assayed. The weight of the tin will be found by subtracting the weight of the copper from that of the button.

On the Estimation of Copper and the Assay of Impure Commercial Cyanides of Potassium,

by M. Flajolot.

This process is founded on the property possessed by cyanide of potassium of decolourising the ammoniacal solution of oxide of copper. The decolouration takes place with great precision, and as no precipitate is formed in the liquid it is very easy to ascertain the moment at which it is complete. The numerous experiments I have made with previously weighed quantities of copper have always given remarkably precise results, which I was far from expecting in the earlier experiments. In operating on a solution the volume of which did not exceed 200 cube centimetres, the error does not exceed two milligrammes, a degree of precision unattainable even by precipitating oxide of copper by potash. But to render the process applicable there must be in solution with the copper none of the metals forming cyanides soluble in ammonia, especially zinc, cobalt, and nickel.

In assaying complex ores like grey coppers, or those which have blende or nickeliferous pyrites for gangue, the copper must first be separated from the other metals. This is easily done by precipitating copper in the state of sulphide by hyposulphite of soda, as I have indicated in the *Annales des Mines*, fourth series, vol. iii. p. 641.

In this kind of analysis I proceed in the following manner:—Let us take grey copper mixed with blende, galena, or all the gangues which may accompany copper ore.

Attack the finely pulverised ore by a mixture of nitric and sulphuric acids in a porcelain capsule, covered by an inverted funnel to avoid projections, and evaporate until the whole of the nitric acid is expelled; then add water and evaporate if necessary; then pour into the boiling solution hyposulphite of soda until the dark tint which at first occurs disappears. The precipitation is known to be complete when the sulphide of copper collects in flakes, floating in a milky liquid. Collect on a filter the sulphide (which will not contain the least trace of iron, zinc, cobalt, nickel, or even lead, but which may contain a little arsenic and antimony), and wash it very rapidly with hot water to prevent oxidation in the air.

Re-dissolve the sulphide in aqua regia, not heeding the antimony and arsenic it may contain, for they do not affect the following reaction. Supersaturate the liquid with ammonia, and pour into it until the colour goes a standard solution of cyanide of potassium, which gives the quantity of copper. The temperature of the cupric solution should not be too high, for less cyanide is required at the boiling point than when cold; up to 40° C. no inconvenience is experienced. Sufficient cyanide of potassium has been added when the blue colour of the liquid gives place to a very faint rose tint.

I use a solution of 15 grammes of cyanide in 50 grammes of water, and determine the standard by dissolving a given quantity of pure copper, say five decigrammes, adding ammonia, and operating as I am about to describe. Since the solution of cyanide of potassium rapidly alters, it should be estimated before each assay.

Ammonide of copper becomes completely decolourisd when there are two equivalents of cyanide of potassium for one of copper, which corresponds to 4·12 grm. of cyanide to one gramme of copper.

If, then, on the one hand, we dissolve 1.12 grm. of cyanide of potassium or testing assay in a little water, and, on the other hand, prepare a solution of ammonide of copper containing one gramme of metal and filling 100 divisions of a graduated burette, and then pour the second solution into the first, until a blue colour begins to appear, it is evident that the number of divisions necessary to produce this result will give in centièmes the richness of cyanide assayed, for the salts mingled with it exert no decolourising influence on the ammonide of copper.

But the operation is easier, the reaction more distinct, by proceeding inversely. For instance, dissolve one gramme of copper in a little nitric acid and add excess of ammonia. Dissolve 8·24 gr. of the cyanide to be tested, so as to have a volume of 200 cubic centimetres, then add this liquid to the first until the colour disappears. It is evident if 22 cubic centimetres are required, the richness of the cyanide is $\frac{100}{12}$. Now that so much cyanide of potassium is manufactured for commercial purposes, so simple and easy a process may prove useful.—*Moniteur Scientifique*, v., p. 78.

American Adulteration.—A parcel of opium, some of which consisted of cakes evidently unbroken, was lately delivered to a laboratory in Philadelphia; one of the cakes, previous to being prepared for drying, was broken, and found to contain sixteen leaden bullets, weighing 7½ oz., evidently incorporated for increasing the weight.

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* *Berg und Hutten*, Zeitsch, 3, 1864, and *Mining and Smelting Mag.*, April, 1864.

TECHNICAL CHEMISTRY.

On a Means of Obtaining Bismuth, by M. Balard.

The high price of bismuth for some years past has induced M. Balard to undertake the search for this metal in old type materials. When it was cheaper, bismuth entered into the composition of the alloy for printing purposes. M. Balard proposes to effect this industrial analysis in the following way:—

1. Dissolve the material in nitric acid, so as to transform all the tin into metastannic acid, which isolate by filtration from the acid solution of nitrates of lead and bismuth; wash with acidulated water, dry and reduce by charcoal.

2. Into the liquid, neutralised as much as possible, plunge plates of lead, which precipitate all the bismuth in a metallic state; dry and melt with a reducing agent.

3. Precipitate the lead from the last liquid by carbonate of soda; separate, wash, dry and reduce with charcoal.

This way of operating gives the three metals in a metallic state; it may undergo several modifications for isolating the metals under another form according to the arrangement of the products. To obtain extremely pure subnitrate of bismuth, says M. Balard, it is necessary only to neutralise the liquid containing the soluble nitrates, and dilute with a large quantity of water naturally free from carbonates, chlorides, or sulphates. After again neutralising and diluting with water and repeating the operations several times, the greater part of this metal becomes isolated in the state of white bismuth.—*Journal de Pharmacie et de Chemie*, xlv. 160.

Extraction of Auriferous Silver from its Ores, by M. J. Nickles.

Though the treatment of argentiferous ores is easy, and that of auriferous ores not very complicated, it is otherwise when the two metals are associated, for then the properties of the one prevent the manifestation of the properties of the other. If, for instance, auriferous silver is treated by chlorine water, the core immediately becomes covered with a coating of chloride of silver, which protects the rest from the action of the solvent. If this is attacked by salt water, ammonia, or hyposulphite of soda, the core becomes unmanageable, the chloride of silver dissolves, it is true, but leaves behind it a layer of metallic gold which in its turn resists the action of the solvents of chloride of silver.

After many tentative trials the simple plan occurred to the author of associating the two solvents, chlorine and chloride of sodium. He took salt water concentrated and saturated with chlorine, and digested the auriferous alloy in it. By burning an ore of this kind and then washing it with the above solvent, the chlorine attacks the metallic particles, and then transforms them into chloride, which is dissolved by the sea salt.

It is thought that this solvent may serve for the treatment of ores so poor in metals as to be discarded for the ordinary extracting processes.—*Polyt. Notizblatt*, vol. xviii. p. 286.

Royal Institution.—Tuesday, April 26, at three, Professor Blackie, "On Homer." Thursday, April 28, at three, Professor Blackie, "On Homer." Friday, April 29, at eight, Professor Williamson, "On the Existence of Atoms." Saturday, April 30, at three, Professor Frankland, "On the Metallic Elements."

PHYSICAL SCIENCE.

Spectrum Analysis.—New Researches, by MM. Mitscherlich, Böettger, Plucker, *and* Hittorf.

A *resumé* of the many interesting researches on spectrum analysis made since its discovery may now be of interest.

While examining a substance containing baryta, M. Mitscherlich* observed two brilliant green rays, seeming to indicate the presence of a new metal. When he introduced into the flame a drop of a solution of chloride of barium mixed with sal ammoniac, he found that these rays appeared either singly or accompanied by those of barium. These same rays took the place of the ordinary barium spectrum, when, above the supporter of a salt of baryta, he placed a bundle of platinum wire impregnated with hydrochloric acid. M. Mitscherlich obtained invariable spectra during several hours by a particular arrangement pointed out in his memoir.

Chlorides of strontium and calcium give spectra very different from those of strontium and calcium, although these new spectra are rarely unaccompanied by those of the metals.

Chlorides of earthy alkaline metals give spectra very unlike the spectra of the metals themselves. The iodides, sulphides, and fluorides of these metals yield no spectra, or, rather, they give those of the metals which are reduced by the carbon and hydrogen of the flame.

The spectra of metallic copper, of chloride, and iodide of copper present essential differences. Sulphide of copper gives no spectrum.

Chloride of potassium mixed with sal ammoniac gives no spectrum. Chloride of sodium, under the same circumstances, shows only the yellow sodium ray. On introducing a bundle of platinum wires, steeped in hydrochloric acid, into a flame giving potassium rays, these rays immediately disappear.

Chlorides of potassium and sodium have no proper spectrum. The result of these experiments is, that metals do not, as is usually supposed, always give the same spectrum, whatever may be the combinations in which they are found.

M. Mitscherlich has proved by the following experiment that it is the metal itself reduced in the flame which produces the spectrum. He introduced some caustic soda into a porcelain tube, heated it to redness, and on examining by the spectroscope the light traversed by the vapours and that emitted by them, found that neither of them showed the sodium line; but on examining the vapours of metallic sodium, under the same conditions, found a brilliant sodium ray.

M. Bœttger observed† that selenium and selenide of mercury gave a spectrum, in which he remarked, from yellow to extreme violet, a great many equidistant dark rays.

Coal gas, after passing through a flask containing chloroform, burns with a green flame, which, analysed by the spectrometric apparatus, shows two blue rays close together, three large green rays comprised between Fraunhofer's rays D and C, and a large blue ray situated between the rays F and G.

Borax gives three or four green rays; protochloride of manganese, four green, and one large orange ray; chloride of bismuth gives numerous brilliant red and blue rays, which rapidly disappear; and chloride of lead gives a number of rays distributed over the entire spectrum.

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* *Bulletin de la Société Chimique.*

† *Bulletin de la Société Chimique.*

M. Erdmann remarked that lime showed a blue ray close to the ray β of rubidium, which might prove a source of error to chemists. According to Dr. Gladstone, didymium may be known by two black rays, one near the ray D, the other between E and C. If the solution of didymium is from eight to ten centimetres thick, seven black rays of various sizes will be visible.

MM. Plucker and Hittorf,[‡] in recent experiments, proved that certain bodies, such as nitrogen and sulphur, do not give a unique spectrum, but, according to the temperature to which the incandescent vapour is submitted, two very different spectra. To ascertain this, they passed through the tubes, containing gas or vapour at a pressure of a few centimetres, first the ordinary current of Ruhmkorff's induction coil, then the same current with its calorific action increased by the interposition of a Leyden jar. By varying the surface of the jar, and thus gradually raising the temperature of the gaseous body, they found that the transition from one spectrum to another was suddenly accomplished. Thus an essential modification must evidently have taken place in the molecular constitution of the body; but with the lowering of the temperature the difference disappeared.

The spectrum corresponding to the lowest temperature, and which MM. Plucker and Hittorf name the first spectrum, is formed of large bands more or less regular, oftener presenting the appearance of channelled spaces cut by black rays. The second spectrum, corresponding to the higher temperature, has brilliant rays on a more or less luminous ground. The brightness changes from one ray to another, quite irregularly.

Sulphur furnishes a striking experiment, showing the abrupt passage from one of the two rays to the other. At the moment the first spectrum attains its maximum of brightness, it suddenly disappears, and gives place to the second spectrum, the richest in brilliant rays which the authors have ever seen. On lowering the temperature the second spectrum disappears and the first reappears.

Oxygen, chlorine, bromine, iodine, &c., have one spectrum only.

To render more precise this entirely new fact, of two absolutely distinct spectra belonging to one simple body, MM. Plucker and Hittorf have studied the spectra of compound gaseous bodies. They have ascertained by spectrum analysis that none of the bodies examined by them resist decomposition by means of the heat from an induction current. Dissociation always took place; the tubes and the molecules of the various simple substances which constitute the compound gaseous body remain under conditions the most favourable to recomposition, as soon as the extreme elevation of the temperature no longer opposes it. It may then be affirmed that there is no such thing as a spectrum of a compound body. Thus, oxide of carbon, carbonic acid, olefiant gas, &c., decompose, and give the spectrum of carbon vapour, one of the most beautiful and curious to behold.

According to MM. Plucker and Hittorf, nitrogen has three spectra, or three different molecular conditions. In the two first conditions nitrogen gives two distinct first spectra, one of a yellow colour, corresponding to the less degree of incandescence; the other, to a higher degree of incandescence, of a blue colour. In the third molecular state, produced by a much more intense state of incandescence, the second spectrum appears.—*Journal de Pharmacie et de Chemie*, xliii., 442.

PHOTOGRAPHY.

Preparation of Alkaline Bromides, by M. Klein.

Bromides of metals of the first section being most used in photography, the author has endeavoured to find a way of preparing them more expeditious than those generally adopted, and it occurred to him to apply a process M. Liebig employs for producing alkaline iodides.

Bromide of Calcium.—Mix one part of finely powdered amorphous phosphorus with thirty or forty parts of water in a capsule placed under the basket-funnel, and gradually add 12·5 parts of bromine. The mixture is effected with disengagement of light, and the liquid becomes heated; then shake it and add the bromine until the mixture begins to decolourise. When all the bromine has been used, heat in a sand bath; and when all the colour has disappeared, add sufficient bromated water to impart a yellow tinge to the solution. Then decant immediately, and neutralise by a slight excess of lime. Filter, wash, and evaporate. The excess of lime carbonates in the meanwhile, which necessitates a second filtration, after which evaporation in a water bath completes the operation.

With 16 grains of amorphous phosphorus, 200 grains of bromine, and about 75 grains of quicklime, the author obtained 230 grains of bromide of calcium. Bromides of barium and strontium may be prepared in the same way.

Bromide of Magnesium.—Neutralise with magnesia the acid liquid obtained by attacking 1 part of phosphorus by 12·5 parts of bromine in presence of water. After filtering, evaporate in a water bath and dry over sulphuric acid.

To Obtain Bromide of Lithium.—Decompose bromide of calcium by carbonate of lithia used at first in insufficient quantities. Leave to digest for twenty-four hours, after which finish the precipitation by carbonate of lithia.

Bromides of potassium and sodium the author obtains by a process previously described for iodides (*Journal de Pharmacie et de Chemie*, xli. 520), that is to say, by the decomposition of bromide of calcium by means of sulphate of potash or soda.—*Journal de Pharmacie et de Chemie*, xlv. 111. 64.

Microscopic Examination of Milk in Health and Disease.—It must be some consolation to those who delight in miserable anticipations of dreadful mixtures in their daily food to know that we possess a method of detecting, with absolute certainty, those combinations of "brains, chalk, and starch," a haunting suspicion of which makes the morning and evening meal distasteful. Without positively asserting that such adulterations never exist, we may aver that we have never met with an instance. Foreign matters, of a nature unsavoury enough, and even unwholesome, we sometimes find, but they are the consequences of a diseased condition, or of an absence of common cleanliness. Such things as particles of dirt, from the milker's hands or the cow's udder, and cuticular scales from the same sources, are common enough. Globules of pus and blood discs are also found less frequently, but still oftener than we like to believe. It will not be thought that the microscope should be the companion to the breakfast-table; but in all cases where there is the least cause for suspicion, its revelations are infallible, and set at rest the doubt that is worse than certainty.—*Dr. Augustus Voelcker, in the Quarterly Journal of Science.*

[‡] *Les Mondes.*

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

WEEKLY EVENING MEETING.

Friday, February 12, 1864.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., Vice-President, in the Chair.*

On the Synthesis of Organic Bodies.

By J. Alfred Wanklyn, Esq., Professor of Chemistry, London Institution.

On this tray you will see a collection of well-known substances.* Compare these substances with one another, and you will be struck with their dissimilarities. Some are solids and crystalline and brittle; others are liquids which are more fluid than water. Some are without colours; others are highly coloured, and are used for dyeing. Some are sweet, others are bitter; some have delightful perfumes, others have dreadful smells; some are wholesome food, others the most powerful poisons known to man.

In spite of this wonderful diversity in their properties, all the specimens on this tray are compounds of carbon, with a very few elements. Carbon, hydrogen, oxygen, and nitrogen are the only elements which occur in this collection of substances. Some of these substances contain carbon and hydrogen; some contain carbon, hydrogen, and oxygen; some carbon, hydrogen, and nitrogen; and some again contain carbon, hydrogen, oxygen, and nitrogen. But not one of the specimens on this tray contains anything besides these four elements.

There is no difficulty in resolving any one of these substances into its ultimate elements. This sugar,† for example, on being heated to redness in a tube, leaves a black deposit, which is carbon, whilst a liquid, which is water, distils over. If we were to electrolyse this liquid, we should obtain hydrogen and oxygen, and so we should exhibit carbon, hydrogen, and oxygen obtained from sugar. Again, instead of heating this sugar in the tube without allowing the air free access to it, we might burn it in excess of oxygen. If we were to do so, we should obtain carbonic acid and water, and, moreover, all the carbon in the sugar would assume the form of carbonic acid, and all the hydrogen the form of water. So we can obtain carbon and hydrogen, either in the free state, or in the very common and well-known forms of combination as carbon acid and water. Nitrogen, when it is present, can be made to assume the form of free nitrogen. For that purpose, all that is requisite is to heat the substance to redness with excess of oxygen, and to adopt certain precautions to avoid the production of oxide of nitrogen.

Thus, the pulling to pieces of these substances on the tray is a matter of very little difficulty: more than fifty years ago chemists could do that; but how to put the pieces together again is a much more difficult task.

Sugar consists of seventy-two parts by weight of carbon, eleven parts of hydrogen, and eighty-eight parts of oxygen. We may bring together carbon, hydrogen, and oxygen in these proportions, and shake them up together, or heat them or cool them, and yet we shall never get them to combine so as to form sugar. Alcohol consists of twenty-four parts of carbon, six parts of hydrogen, and sixteen parts of oxygen, but no alcohol ever results from making such a mixture. Neither sugar nor alcohol can exist at the temperature to which it is requisite to raise our mixture of carbon, hydrogen, and oxygen, in order to get chemical action to set in. At ordinary temperature the organic elements will not enter into combination, whilst at high temperatures they combine, it is true, but yield comparatively very few compounds.

It was long after chemists had effected the analysis of organic bodies before they learnt how to effect the synthesis of even one of them, and hence the belief sprung up that organic products, such as those on our tray, were intrinsically different from mineral products. Whilst stones, water, and the like were regarded as having their ultimate particles held together by mere dead forces, sugar, alcohol, &c., were regarded as being held together by vital forces, as being, in short, in some subordinate way, alive.

Now, no more positive refutation of this notion can be imagined than the artificial construction of substances, in every respect, like those obtained from the animal and vegetable kingdoms; and hence some of the philosophical interest attached to the problem which forms the subject of this discourse.

The first definite example of the construction of an organic body from inorganic materials was given by Wöhler in 1828, when he made the organic base urea from cyanate of ammonia.

Let us trace the steps of this process. Cyanide of potassium—a body which can exist at a red heat (some cyanide of potassium was exhibited in the form of tabular masses which had been fused), and which can, moreover, be formed directly from its constituents (carbon, nitrogen, and potassium)—was oxydised by means of peroxide of manganese at a low red heat, and so cyanate of potash was obtained. The cyanate of potash was next converted into cyanate of ammonia by double decomposition with sulphate of ammonia. Thus cyanate of ammonia was produced from its elements by a process which, although indirect, still did not involve the action of either a plant or an animal. Cyanate of ammonia becomes urea when its solution in water is simply evaporated to dryness.

It was curious that the first organic body to be constructed should have been a nitrogenous compound.

In 1831, three years after this important discovery of Wöhler's, formic acid—the first term of the fatty acid series—was obtained from inorganic materials by Pelouze. The process was this:—Hydrocyanic acid, a body capable of being obtained from inorganic materials, was heated either with strong alkalis or acids, and was so made to react upon the elements of water as follows:—

$$\overbrace{CNH}^{\text{Hydrocyanic Acid.}} + 2H_2O = NH_3 + \overbrace{CH_2O_2}^{\text{Formic Acid.}}$$

and yielded formic acid.

It does not appear that this research of Pelouze's attracted that attention which it deserved. This we must attribute to the circumstance that at this period the position of formic acid in the organic series was not recognised.

The next step of importance in organic synthesis was taken by Kolbe in 1845. It was the synthesis of acetic acid, the second term of the fatty series. Kolbe's process was this:—Sulphide of carbon, obtained by the direct combination of carbon with sulphur at a red heat, was submitted to the action of chlorine at a red heat, by which means certain compounds of carbon and chlorine were obtained. One of the compounds, C_2Cl_4, was then acted upon by chlorine in the presence of water, and tri-chlor-acetic acid resulted.

Having thus got tri-chlor-acetic acid by thoroughly inorganic means, Kolbe availed himself of the observation which had been made of *Melsens*, that treatment of tri-chlor-acetic acid with potassium-amalgam and water converted it into acetic acid.

Kolbe was fully sensible of the scope and importance of his discovery. The following passage occurs in his paper, published in Liebig's *Annalen* for 1845:—"From the foregoing observations we deduce the interesting fact that acetic acid, hitherto known only as a product of the oxidation of organic materials, can be built up by almost

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* A tray, with a number of organic bodies lying upon it, was before the speaker.

† Cane sugar was heated to redness in a tube.

direct synthesis from its elements. Sulphide of carbon, chloride of carbon, and chlorine are the agents which, along with water, accomplish the transformation of carbon into acetic acid. If we could only transform acetic acid into alcohol, and out of the latter could obtain sugar and starch, then we should be enabled to build up these common vegetable principles by the so-called artificial method from their most ultimate elements." Thus it appears that Kolbe looked forward to the building up of organic bodies in general, and that he was quite alive to the fact that the synthesis of acetic acid completed the synthesis of the derivations of acetic acid.

Among these derivations may be enumerated acetone, the product of the destructive distillation of acetates; marsh gas obtained by distilling an acetate with a caustic alkali; ethylene, obtained by Bunsen by heating kakodyl, which itself results by the action of arsenious acid upon an acetate. The electrolysis of acetic acid, which Kolbe accomplished a few years afterwards, yielded methyl and oxide of methyl, which latter in its turn could be transformed into any other methylic compound.

Marsh gas was, moreover, prepared by Regnault by treating CCl_4 with nascent hydrogen; and the common methylic compounds appear to have been produced by Dumas from marsh gas, the chloride of methyl having been obtained by Dumas, by the action of chlorine upon marsh gas.

Before 1854, all the foregoing synthesis were fully completed, *i.e.*, there was no step missing between the elements themselves and the most complex compound reached; but, in addition to these complete and definite syntheses, there had also been a good deal of building up of an incomplete or of a less definite character before 1854.

It was known, in a general way, that organic bodies of tolerably simple composition sometimes gave complex products on destructive distillation. Thus, alcohol was known to give naphthaline, benzol, and carbonic acid when it was pressed through a red-hot tube. Formiates were also known to yield hydro-carbons when they were subjected to destructive distillation. The precise dates of these different observations I cannot give, but hand-books of chemistry published before 1854 contain a statement of the facts.

A few years after 1820, before Wöhler's celebrated Synthesis of Urea, a very remarkable instance of passage from a simpler to a more complex compound was given by Faraday and Hennell. This example is placed along with the indefinite syntheses because it was generally disbelieved in by chemists, and only within the last few years, when it was confirmed by Berthelot, received the general assent. Faraday and Hennel found that olefiant gas was absorbed by sulphuric acid and gave sulpho-vinic acid, from which, of course, alcohol and the ethers might be procured. Liebig denied what Faraday and Hennell had asserted, and the latter did not insist upon the correctness of their work, and did not take the necessary steps for ensuring the reception of their results.

Shortly before 1854 a most capital addition to the art of organic synthesis was borrowed from the doctrine of the homologous series. I will endeavour to explain it.

Organic bodies repeat themselves: thus common alcohol has a whole series of representatives, differing from it in formula by n (CH_2), but resembling it very closely in chemical functions. Alcohol and these its representatives constitute a homologous series. Every one of these representatives (homologues) of alcohol possesses a set of ethers and other derivatives, just as common alcohol possesses its ethers and derivatives. With certain limitations, it is true that whatever reaction can be accomplished with one alcohol can be accomplished with any other alcohol of the series.

Synthesis by series will then be easily understood by an example. Suppose we obtain a building-up by starting with common alcohol, we should infer that an analogous building-up could be made by starting with any other alcohol of the series.

Here follows a table of the homologous series of alcohols, and of the homologous acids which are related to them:—

Methyl	alcohol	CH_4O	CH_2O_2	Formic	acid.
Ethyl	,,	C_2H_6O	$C_2H_4O_2$	Acetic	,,
Propyl	,,	C_3H_8O	$C_3H_6O_2$	Propionic	,,
Tetryl	,,	$C_4H_{10}O$	$C_4H_8O_2$	Butyric	,,
Amyl	,,	$C_5H_{12}O$	$C_5H_{10}O_2$	Valerianic	,,
Hexyl	,,	$C_6H_{14}O$	$C_6H_{12}O_2$	Caproic	,,
,,	,,	,,	,,	,,	,,
Cetyl	,,	$C_{16}H_{34}O$	$C_{16}H_{32}O_2$	Palmitic	,,
,,	,,	,,	,,	,,	,,
Ceryl	,,	$C_{27}H_{56}O$	$C_{27}H_{54}O_2$	Cerotic	,,

A good example of synthesis by series was furnished by Frankland and Kolbe, who showed that various cyanides of the alcohol-radicles yield the next higher acid in the series when they are digested with an alcoholic solution of potash, thus:—

$$\overset{\text{Cyanide of Methyl.}}{\left.\begin{matrix}CH_3CN\\+2H_2O\end{matrix}\right\}} = \overset{\text{Acetic Acid.}}{\left\{\begin{matrix}C_2H_4O_2\\+NH_3\end{matrix}\right.}$$

The effect of the alkali is to cause decomposition of water by means of the cyanide, and the reaction very closely resembles Pelouze's, of which mention has already been made.

By means of this synthesis, which is general to the whole series, chemists acquired a method of ascending from any given alcohol to the acid belonging to next higher alcohol. It will be evident, however, that this step, important though it was, did not suffice to enable chemists to march regularly up the ladder. The step from acetic acid to alcohol—from an acid to an alcohol of the same carbon-condensation—was wanting.

This synthesis by series was an incomplete synthesis; there was a gap requiring to be filled up, in order that the regular march might be made up the vinic series.

From the foregoing, it will be seen that by the year 1854 very considerable progress had been made in the building-up of organic bodies from their ultimate elements.

We now pass on to the consideration of the period comprising the last ten years, from 1854 up to the present time.

During this period we have had new methods of accomplishing some of the syntheses which had been effected previously. Thus, formic acid, which, as we have seen, had been formed from inorganic materials so long ago as 1831, was built up by Berthelot by means of carbonic oxide and caustic potash,—

$$CO + KHO = CHKO_2$$

and again by Kolbe, by using carbonic acid, moisture, and sodium (the moisture and sodium giving nascent hydrogen),

$$CO_2 + H + Na = CHNaO_2.$$

Again, also, the passage from an alcohol to the next higher acid was repeated. Carbonic acid and a compound of an alcohol radicle with an alkali metal coalesced, and formed a salt of a fatty acid, thus:—

$$CO_2 + \overbrace{NaC_2H_5}^{\text{Sodium-ethyl.}} = \overbrace{C_3H_5NaO_2}^{\text{Propionate of Soda.}}.‡$$

Still these reactions, however interesting they might be, were not new syntheses; they were only new methods of effecting old syntheses.

The great problem, how to step from one alcohol to that next above it, has received a general solution from Mendius. Mendius used cyanogen compounds, those hydrocyanic ethers which had already done such good service to organic synthesis, and exposed them to the

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‡ The experiment was shown, and the great evolution of heat which took place on bringing carbonic acid into contact with sodium-ethyl was apparent.

action of nascent hydrogen, and so obtained amides of alcohol-radicles higher than the alcohol-radicles started from. The reaction bears a close similarity to the one which takes place between the cyanides and alcoholic solution of potash, and which, as will be remembered, enabled us to pass from the alcohol to the acid next above.

Here is a scheme to show the parallel:—

Transformation to Amide.

$$\overset{\text{IV}}{\text{C}}\left\{\begin{matrix}\text{N}''' \\ \\ \text{C}_2\text{H}_5'\end{matrix}\right. \qquad\qquad \overset{\text{IV}}{\text{C}}\left\{\begin{matrix}\text{NH}_2' \\ \text{H} \\ \text{H} \\ \text{C}_2\text{H}_5\end{matrix}\right.$$

Transformation to Acid.

$$\overset{\text{IV}}{\text{C}}\left\{\begin{matrix}\text{N}''' \\ \\ \text{C}_2\text{H}_5'\end{matrix}\right. \qquad\qquad \overset{\text{IV}}{\text{C}}\left\{\begin{matrix}\text{HO} \\ \text{O}'' \\ \text{C}_2\text{H}_5'\end{matrix}\right.$$

In the one case nitrogen is replaced by NH_2 and H,H; and in the other by HO′ and O″.

Mendius was able to commence even with hydrocyanic acid. The steps in his synthesis are these:—

Hydrocyanic Acid to Methylamine.

$$(1) \qquad CNH + H_4 = CH_3NH_2.$$

Methylamine, by means of nitrous acid to methyl-alcohol: methyl-alcohol to cyanide of methyl, well-known processes being employed to effect this:—

Cyanide of Methyl to Ethylamine.

$$(2) \qquad CNCH_3 + H_4 = C_2H_5NH_2.$$

From ethylamine it is easy to get cyanide of ethyl, from which, by a third repetition, we arrive at the propylic stage:—

$$(3) \qquad CNC_2H_5 + H_4 = C_3H_7NH_2.$$

Thus the vinic series may be ascended: thus there is reason to think we may begin with so simple a body as prussic acid, and step by step proceed from one alcohol to the next above it, until we reach the fats and the waxes. There are other methods of effecting the synthesis of the alcohol series, but none of them seem to be so complete and satisfactory as this:—Berthelot has obtained alcohols by adding the elements of water to the olefines, and some of the olefines he has obtained by the destructive distillation of formiates; but it is an open question—how many olefines can be got by heating the formiates? And, at any rate, there is no precision in the preparation of olefines from formiates.

A very neat and beautiful way of preparing one olefine, viz., common olefiant gas, is, however, due to Berthelot. He exposes charcoal to the action of hydrogen at a very high temperature—the temperature of the electric arc—and then union takes place, resulting in the formation of acetylene: $C_2 + H_2 = C_2H_2$

Acetylene exposed to the action of nascent hydrogen in an alkaline liquid gives olefiant gas:—

$$C_2H_2 + H_2 = C_2H_4$$

Friedel and Wurtz have converted aldehydes and ketones into alcohols by the action of nascent hydrogen, and thence there arises another method of ascending the vinic series, and besides there are a number of other reactions which are capable of more or less general employment for the purpose of building up the alcoholic series, but which we have not time to particularise.

The alcohols having been got, many other important organic compounds follow, and there is good reason for believing that with the progress of the science all will be derived from them, so that the series of the alcohols will constitute a kind of backbone to organic chemistry.

Most modern organic researches are capable of being looked at from a synthetical aspect, for they generally disclose how to devise some organic bodies from compounds which either themselves are, or will be, capable of complete synthesis. Glycerine, the base of the fats, has been derived from the propylic series, having been obtained, by Wurtz, by a somewhat circuitous process from propylene—the olefine of that series.

The sugars have not been, as yet, unequivocally produced, but they will be, for their connexion with the hexylic series is now placed beyond a doubt. The production of glycerides from glycerine and fatty acids is the proof that the natural fats are within our grasp. The aromatic series, with its many derivations, among which may be mentioned the wonderful aniline dyes, which rival those got more immediately from the animal and vegetable kingdoms, becomes accessible to synthesis through common alcohol, which, on being heated to redness, gives benzol and carbolic acid—members of the aromatic series.

Wurtz's compound ammonias, and, above all, the immense and wonderful development of the class of compound ammonias arising from the labours of Hofmann are the pledge that the natural alkaloids—quinine, morphine, strychnine, and their congeners—will one day be within our reach.

Glycocoll, produced by Perkin and Duppa from acetic acid, and the bases of the juice of flesh, which have been recently formed by Vollhardt and Hofmann, assure us that albumen—that essential ingredient of our food—will not elude us.

Why should those medicines and foods which we find in nature be the most useful which are possible? Would it not rather be strange if they were?

Hereafter, perhaps, medicines as much more potent than quinine, as quinine is than the extracts of the commonest herb that grows wild, may be the produce of our laboraties.

PHARMACEUTICAL SOCIETY.

April 13.

Dr. Attfield delivered the first of two lectures "*On the Relation of the British Pharmacopœia to Pharmacology.*" The lecture was devoted to a critical examination of the Pharmacopœia, with the view of showing how far the compilers had, or had not, availed themselves of the results of recent chemical and pharmacological investigations. With this purpose the lecturer proceeded to notice many of the preparations and processes, comparing the latter with others which have received the sanction of eminent chemists and pharmacologists, and introducing explanatory remarks whenever it appeared desirable. Noticing benzoic acid, Dr. Attfield regretted that the lime process had not been introduced into the Pharmacopœia, instead of the old one of sublimation. In the preparation of citric acid it was pointed out that the fermentation must be quite completed before the chalk is added, since citrate lime is apt to ferment and yield butyric as well as acetic acid. A new process altogether, the lecturer thought, was advisable for the preparation of dilute phosphoric acid, that of the Pharmacopœia being liable to accident, and the dilution of glacial acid, being on other accounts objectionable. The re-distillation of sulphuric acid he considered unnecessary, unless nitrous compounds or arsenious acid, or both, are present. The acid should, therefore, first be tested, and if arsenious acid is present without nitric acid, the latter should be added, and, after the application of some heat, the sulphate of ammonia added, and the distillation effected. Speaking of tannic acid, Dr. Attfield pointed out the importance of using the officinal ether with 8 per cent. of alcohol, since it has been shown that a much more satisfactory result is thereby obtained. The omission to direct the addition of ammonia when evaporating the solution of benzoate of ammonia was mentioned. By the Pharmacopœia process the operator is certain to obtain a bi-benzoate, as was shown long ago by Berzelius. Alluding to the process for making antimonium sulphuratum, Dr.

Attfield objected to the term "prepared" sulphuret of antimony, when only powdered was meant, and suggested that this substance should have been ordered to be freed from its ordinary impurity—sulphide of arsenic—which could be done by digesting the powdered sulphuret of antimony in strong ammonia. He also objected to the term bismuthum album, the adjective being applicable to all the white compounds of the metal. Of the directions for the purification of chloroform, the lecturer spoke with approval, and dwelt on the importance of leaving the crude product in contact with sulphuric acid but for a short time, and of rectifying with slaked lime as well as chloride of calcium. The faulty process for collodium (which remains unamended in the small edition of the Pharmacopœia), it was explained, was an accidental direction, the author of the process contemplating the use of a weaker nitric acid than that which was at last adopted by the committee. Speaking of emplastrum cantharidis, the lecturer showed how completely the compilers of the Pharmacopœia had ignored, or were unacquainted with, the researches of several experimenters who have proved the advantage of heating the powdered flies for some time with the fatty ingredients. When this is done the cantharidin is dissolved, and every part of the plaster is active. In the directions for the preparation of extracts, it appeared that the suggestions of numerous pharmaceutists who have written on the subject have been attended to, and the processes were, for the most part, approved. The processes for the iron preparations next noticed were also, for the most part, commended; but Dr. Attfield objected to the names of the two oxides as not being explanatory of their composition. The Ferri peroxidum of the Pharmacopœia is, as shown in the formula given, a hydrated oxide; while the Ferri peroxidum hydratum is really a moist hydrated peroxide, or a terhydrated peroxide, when recently precipitated, and becomes the compound indicated by the formula of the Pharmacopœia, $2Fe_2O_3 3HO$, only after being kept some time under water. Ferri sulphas granulata the lecturer believes to be a partially dehydrated sulphate of iron containing six instead of seven atoms of water. The ordinary sulphate would appear, from the experiments of several authors quoted, to have water lodged between the plates of the crystals, which carrying oxygen from the external air, leads to the rapid oxidation of the salt. This mechanically adherent water is removed by the spirit, and hence the granular sulphate oxidises less readily. The proportions of oxide of iron and acid tartrate of potash for the Ferrum tartaratum are those given by Mr. Bastick, and yield a compound quite in accordance with the formula of the Pharmacopœia. The adoption of the names calomel and corrosive sublimate for the well-known mercurial salts Dr. Attfield showed to be an unnecessary innovation, since the atomic constitution of the mercurial salts may be considered to have been finally settled by Dr. Frankland some months before the publication of the Pharmacopœia, and the older names chloride and bichloride of mercury shown to be perfectly correct. The retention of Hydrargyrum cum cretâ was objected to by the lecturer on account of the uncertainty of its action, resulting from the variable proportions of red and black oxide of mercury which may be present. Speaking of the infusions, it was pointed out that the directions for Infusum calumbæ might be improved by ordering the strained product to be heated to boiling in order to effect the coagulation of the albumen, as recommended by Squire and Greenish. The process for Liquor ferri perchloridi Dr. Attfield objected to as the worst which could have been chosen. It gives a mixture of perchloride and pernitrate, for the whole of the nitric acid is not removed by the boiling. It would be better, he thought, to make the tincture from the solid chloride, and the easiest way of obtaining a pure and definite perchloride of iron, he said, was by passing dry chlorine into a mass of warm iron nails contained in a flask. Micaceous crystals of the sesquichloride are at once formed, and may be sublimed into a bottle without difficulty by the application of heat.

Dr. Attfield continued his criticism of the Pharmacopœia on the 20th inst., and we shall proceed with our report next week.

ACADEMY OF SCIENCES.

April 11.

The first paper was by M. Peligot, "*On the Alloys of Silver and Zinc.*" In consequence of the increasing scarcity of silver money in France, which is constantly disappearing from circulating on account of the continued rise in the value of the metal, the French Government is about to lower the standard of the silver coinage by the addition of about 7 per cent. more copper. The new money will be made of an alloy consisting of 835 parts silver and 165 parts copper. M. Peligot is chemist to the French Mint, and he has made experiments to ascertain how the introduction of some zinc or the complete substitution of zinc for the copper would affect the alloy. He has found that alloys of the legal standard in which part or the whole of the copper was replaced by zinc are remarkably malleable, and when rolled are perfectly homogeneous. They are of a beautiful white colour, but the binary alloy of silver and zinc is somewhat yellowish. The fusibility of the zinc alloys is greater than the copper; they are very sonorous and elastic, and if made brittle by hammering the malleability is restored by heating. The study of the atomic alloys showed curious results. Equal equivalents of silver and zinc, or two equivalents of silver to one of zinc, gave malleable alloys, while the compounds $Ag + 2Zn$ and $2Ag + 3Zn$ are too brittle to be rolled. As a matter of economy, the author recommends that his government should employ zinc to reduce the value of the present money, the price of zinc being only one-fifth that of copper. Another recommendation to the zinc alloy is the fact of its blackening less readily with sulphuretted hydrogen than the copper compound, copper, indeed, seeming to increase the discolouration. An alloy of 800 of silver and 200 of zinc will keep its whiteness in a solution of a polysulphide, which will rapidly blacken the legal alloy of copper and silver. This, as the author points out, will be useful information to the makers of jewellery. The absence of verdigris under the action of acid liquors is another advantage. In conclusion, the author mentions a fact of no great importance to us, namely, that the introduction of zinc into money is nothing new. French copper money contains one per cent. of zinc, and the small coins of Switzerland contain zinc, silver, and nickel.

M. Cahours presented another memoir "*On the Respiration of Fruits.*" He has found that if a fruit is placed in either nitrogen or hydrogen it evolves carbonic acid, and the volume of the gas outside is increased. Hence it follows that the carbonic acid must result from changes inside the fruit independent of the external atmosphere. What are the changes? It is a sort of fermentation which goes on, says the author. It is the detruction of the tannoid matters, says M. Chatin, which always takes place as a fruit ripens and rots. [Will any reader make an experiment with some medlars, and settle the question?]

Here M. Fremy steps in with some "*Remarks on the Maturation of Fruits,*" in which he states that he and M. Decaisne settled the whole question some time ago. According to these gentlemen, there are three stages in the existence of a fruit. In the first stage, that of development, the fruit is green, and behaves to the atmosphere like a leaf decomposing carbonic acid in solar light and evolving oxygen. In the second stage, that of ripening, the green colour changes to yellow, brown, or red; the fruit then transforms the oxygen of the air into carbonic acid, which is produced in the cellules of the pericarp in consequence of a series of slow combustions, in which the immediate soluble principles disappear. Tannin goes first, then acids, and afterwards sugar. In the third stage, that of decomposition, the effect of which is the destruction of the pericarp and the liberation of the seed, air enters the cellules, sets up the alcoholic fermentation, and the acids of the fruit give birth to true ethers. Finally, it not only decomposes the cellules, but it oxidises certain immediate principles which have resisted the changes in ripening. Here we find that M. Fremy has anticipated us with the medlars, which, he says, everybody knows are at first very acid and astringent, and only become eatable when they are mellow.

A very interesting paper by the Abbé Laborde was read entitled "*Permanent Stratification Produced by the Induction; New Arrangement of Interrupters.*" By connecting a collodion plate which has been exposed and developed, the author (if too much silver is not reduced, and so the plate made too good a conductor) gets a permanent figure of the stratification of the induction spark. To obviate the disadvantages of the ordinary contact breaker, the author has contrived an arrangement by means of which one end of an oscillating lever is made to dip further into the mercury before it escapes to break the contact, and thus the whole force of the current is obtained. We shall describe this arrangement at length on an early occasion.

M. Naguet replied to M. Kekule "*On the Atomicity of Elements*" (see No. 226, p. 157). He still believes that oxygen, sulphur, selenium, and tellurium are tetra-atomic.

M. Baudrimont communicated a very interesting note "*On Sulphur considered as a Constituent Element of Amber.*" All the specimens of amber which the author experimented upon he found to contain a small proportion of sulphur, which he believes to exist there in combination with organic matter, and therefore to be a natural constituent, and not derived from the materials in which it is found. The succiniferous plants, he thinks, must have contained sulphur, as the cruciferous and alliaceous do now. M. Baudrimont can find no sulphur in copal and Dammar resins.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

April 5, 1864.

E. W. BINNEY, *F.R.S.*, *F.G.S.*, *President, in the Chair.*

MR. JOHN EASTHAM was elected an ordinary member of the Society.

Messrs. H. M. Ormerod and G. C. Lowe were appointed auditors of the society's accounts for the present session.

Mr. BOTTOMLEY gave the results of some experiments upon the estimation of sulphur made according to a method devised some time ago by M. Pelouze. This method had been brought under the notice of the society by Dr. Calvert as being a quick and approximate one. The present experimenter had, however, obtained these approximations within such wide limits that he had not found the process available for the purpose intended. In these experiments, 20 grains of the ore, very finely powdered, were mixed with 100 grains of carbonate of soda, 100 grains of chlorate of potash, and 140 grains of common salt. The carbonate of soda and common salt were always heated previous to an experiment, to ensure their being quite dry. These materials were well mixed for about ten minutes in a porcelain mortar. In all cases the mixture quietly deflagrated without throwing any particles out of the platinum crucible. The following were the results obtained :—

	True Percentage.	Percentage by Alkalimetry.
1. . . .	36·98	33·20
2. . . .	40·75	36·95
3. . . .	38·44	38·80
4. . . .	39·04	42·11
5. . . .	36·87	41·70

In the two first experiments the materials were kept fused at a low red heat for some time after deflagration had ceased. In the three last experiments the lamp was removed soon after deflagration had taken place. In the filtrate from the first experiment arseniate of soda was found. In the fourth and fifth experiments arsenic was also found, but not in quantities adequate to account for the difference between the two percentages. These wide differences between the results in the two columns no doubt depend upon the fact that the chlorate of potash does not act merely as an oxidising agent, but gives up some chlorine. In all cases some oxygen compound of chlorine has been evolved with the carbonic acid. It is worthy of remark that many years ago it was stated by Vanquelin that the residue obtained after decomposing chlorate of potash was sensibly alkaline.—(*Ann. de Chimie et de Physique*, xcv., 101.) A few grammes of chlorate of potash were heated in a platinum dish for a few minutes, until the fluid mass began to solidify. This residue dissolved in water gave a solution that seemed faintly alkaline, so faint, however, as to be scarcely perceptible. Prolonged heat and perfect decomposition of perchlorate of potash might perhaps have made it more marked. The above experiments were made in Mr. Spence's laboratory. The same method had been tried in Mr. Rumney's laboratory, by Mr. Bocharoff; his results, however, did not agree with the true percentage. He also ascribed the disagreement to the same cause as that suggested in this notice.

Mr. BAXENDELL gave the details of some observations he had lately made at Southport to determine the velocities of rifle balls. Three kinds of rifle were used by the firing party—the Whitworth, the Henry, and the Enfield; and the distance of the target being 600 yards, it was found that the average times required by the balls to traverse this distance were :—

	Seconds.
With the Whitworth rifle . .	1·59
,, Henry	1·75
,, Enfield. . . .	1·87

The velocities were therefore—

	Feet per Second.
With the Whitworth rifle . .	1132
,, Henry	1028
,, Enfield. . . .	962

The differences between individual results were greatest with the Enfield rifle, and least with the Whitworth; and number of points made was greatly in favour of the Whitworth instrument, the accuracy of fire apparently increasing in a greater ratio than the increase in the velocity of the balls. It was understood that the charges of powder used were those which experience had shown to be best adapted for each form of rifle.

New Method of Colouring Woods.—The surface to be coloured is smeared with a strong solution of permanganate of potash, which is left on a longer or shorter time, according to the shade required. In most cases five minutes suffice. Cherry and pear-tree woods are most easily attacked, but a few experiments will serve to show the most favourable circumstances. The woody fibre decomposes the permanganate, precipitating peroxide of manganese, which is fixed in the fibre by the potash simultaneously set free. When the action is ended, the wood is carefully washed, dried, and afterwards oiled and polished in the ordinary way. The effect of this treatment on many woods is said to be surprising, particularly on cherrywood, to which a very beautiful reddish tone is communicated. The colour is in all cases permanent in light and air. — *Dr. Wiederhold, Neues Gewerb. für Kurhessen*, 1863, s. 194.

NOTICES OF BOOKS.

Journal für Practische Chemie. Nos. 23 and 24. 1863.

The last number of the above Journal received contains a paper by C. Jackson, "*On the Recognition of Alumina by means of Carminic Acid, and the behaviour of Various Carminic Salts to several Re-agents.*" The results obtained by the author in his experiments are curious, but not perhaps sufficiently characteristic to be made useful. He considers that a carmine paper prepared by colouring with cochineal tincture, Swedish filtering paper, already acidulated with acetic or hydrochloric acid, may be used to detect alumina in minute quantity in either neutral, acid, or alkaline solutions. The acidulated paper is orange or flesh coloured, but after contact with alumina it becomes when dry of a carmine red colour. Von Bibra gives an elaborate paper "*On the Chemical Ingredients of some Limestones.*" The limestones experimented upon were all found in Germany. Rochleder has an interesting communication "*On the Crystalline Ingredients of the Bark of the Horse-chesnut Tree.* The author gives an account of fraxin, æsculin, æsculetin, and another body obtained in very small quantity, having the composition $C_{24}H_{28}O_{30}$, together with an account of their chemical properties. A paper "*On Morin and Morintannic Acid,*" by Hlasiwetz and Pfaundler follows. The name, morintannic acid, the authors think inapplicable to the substance, which possesses no acid properties; they therefore propose *Maclurin* from *Macluria tinctoria*, the botanical name of the fustic tree. The so-called morintannic acid, when treated with hot caustic alkali, they find splits up into an acid and phloroglucin. The acid appears to be identical with the protocatechuic acid of Strecker, the carbo-hydrocinchonic acid of Hesse, and the oxy-salicylic acid of Lautemann. The same authors have also a communication "*On Quercitrin Sugar,*" which they state to be isomeric with mannite and melampyrin. It forms a weakly explosive nitro-compound. The *Notizen* contain but little which has not already appeared in the Chemical News.

Poggendorff's Annalen der Physik und der Chemie. No. 3, 1864.

This Journal opens with an elaborate paper by Rammelsberg, *On the Sulphur Compounds of Iron, the Composition of Magnetic Pyrites, and the Occurrence of Sulphuret of Iron in Meteoric Iron.* The author endeavours to answer the following questions:—What is the composition of the products obtained by heating iron and sulphur or oxide of iron and sulphur at high and low temperatures? What compound remains behind after heating iron pyrites? Are iron sulphuret (FeS) and magnetic pyrites formed in the same way at different temperatures? A short paper, *On Meteoric Sulphide of Iron*, by the same author, follows, and is succeeded by another, giving *the specific gravities of several compounds of iron and sulphur.* Brodie's paper, *On the Peroxides of the Radicals of Organic Acids*, comes next. Müttrich's learned paper, *On the Optical Properties of Crystals, and of Rape Oil and Distilled Water at different Temperatures*, is concluded. A communication by A. Mitscherlich, *On the Spectra of Simple and Compound Bodies*, and some *Researches on Electrical Appearances*, by F. C. Henrici, follow, and the number concludes with a short paper, *On the Condition of the Sun*, by Magnus, in which he mentions some interesting experiments on the influence of soda, solid and in vapour, on the radiation of heat.

Zeitschrift für Chemie und Pharmacie, &c. Heft 7. 1864.

In the last Number of the above journal, Griess announces the discovery of a new series of organic acids, obtained by treating nitrobenzoic acid with the hydrate of potash. Hlasiwetz and Gilm have procured two new acids by treating berberin with the same reagent. The same authors have obtained two new bodies by carefully fusing guaiacum resin with caustic potash. The first is a crystalline acid, and the second an amorphous body, which also appears to be an acid. From galbanum resin, Hlasiwetz and Barth have, by similar treatment, procured a new body homologous with Orcin, and possessing nearly all the properties of that body. Drs. Erlenmeyer and Hoster announce the discovery of oxalic and glycollic acids in the juice of unripe grapes. This is an important discovery in connexion with vegetable physiology and chemistry.

The British Pharmaeopœia. Smaller Edition.

We need only announce the issue of this edition, which the profession has waited for very patiently for some months. There are, of course, no substantial alterations from the larger book. One or two obviously clerical errors in the manuscript have been corrected; and the directions for the preparation of hydrochloric acid have been amended by ordering the application of heat; but with these exceptions the contents of the two books are identical. It would have been impossible, we presume, to make any important changes in the book, and the Pharmacopœia must remain as it is, we suppose, for the next ten years, unless the Medical Council candidly admit the failure, and proceed at once to a complete revision, which report says is about to be done.

A Treatise on Pharmacy; designed as a Text-book for the Student, and as a Guide for the Physician and Pharmaceutist, &c., &c. By Edward Parrish. Third Edition. Philadelphia: Blanchard and Lea. 1864.

For the present we must content ourselves with merely noticing the arrival of this book. We have had occasion to speak very highly of former editions, and in this we find large additions of important matter, rendered necessary by the recent publication of the United States' Pharmacopœia, which greatly increases the value of the work.

We shall notice the book at greater length very shortly.

The Preparation and Mounting of Microscopical Objects. By Thomas Davies. London: Hardwicke. 1864.

This is a really useful and, moreover, a very cheap book, which we can confidently recommend to all beginning the use of the microscope. Practised hands will also find many original and valuable hints and directions scattered about its pages.

NOTICES OF PATENTS.

2909. *Manufacture of Zinc Oxide.* G. Darlington, Minera, Denbigh. Dated October 29, 1862.

The preparation of white oxide of zinc for paint, &c., is conducted on the principle of using a smokeless carbonaceous fuel (anthracite or charcoal) in combination with the zinc ores, and leading the zinc fumes from the reduction furnace into an adjoining condensing-chamber freely supplied with atmospheric oxygen. The quality of the product is said to be remarkably good, especially as regards purity of colour.

2913. *Treatment of Copper Ores.* W. Clark, Chancery Lane, London. A communication. Dated October 29, 1862.

For the more ready extraction of metallic copper from the fused regulus, and sulphuretted ores or products of that metal, the inventor directs a blast of air, with or without steam, into the furnace in which the reduction is being effected.

5937. *Carburetting or Naphthalising Gas.* W. R. Bowditch, Wakefield. Dated October 31, 1862.

The patentee describes and gives drawings of an apparatus intended to be employed in increasing the illuminating power of coal gas. The use of volatile hydrocarbons is resorted to, and heat applied as a means of augmenting the light-producing power of these fluids.

2982. *Dyeing.* P. W. Reuter, Buckland Crescent, St. John's Wood. A communication. Dated November 4, 1862.

The essence of this invention consists in the use of compound solution as a preparative in the dyeing of wool. The liquor is made by boiling together oxide of lead, carbonate of soda, and milk of lime, and the wool is treated at once with this solution at about 180° Fahr., or with the previous addition thereto of the colouring matters. Wool thus dyed is then passed through the soap bath, and finally washed in very dilute hydrochloric acid for the purpose of removing every trace of these alkaline matters, and at the same time brightening the colour.

3157. *Deodorising Mineral Oils and Hydrocarbons.* J. Moule, Hackney Road. Dated November 25, 1862.

For the disinfection of crude petroleum and rock oils, the inventor treats them with nitrous acid or with gaseous binoxide of nitrogen, either of which agents will entirely remove the disagreeable odour appertaining to the crude oils of this class. The products from coal-tar naphtha and paraffine oil may likewise be treated in this manner.

Grants of Provisional Protection for Six Months.

292. Henry Edwin Drayson, Southampton, "An improvement in the manufacture of gunpowder."—Petition recorded February 4, 1864.

497. Frederick Weil, Paris, "Improvements in coating metals with one or several other metals, and in oxydising the surface of these latter."

503. Joseph Wilson Swan, Gateshead, Durham, "Improvements in photography."—Petitions recorded February 29, 1864.

519. William Miller, High-street, Hull, Yorkshire, "Improvements in the manufacture of sugar, and in the apparatus employed therein."—Petition recorded March 2, 1864.

542. William Ibotson, Wraysbury, Middlesex, "Improvements in the manufacture of paper, and in machinery employed therein."—Petitions recorded March 3, 1864.

552. Alexandre Manbre, Baker Street, Portman Square, London, "Improvements in the manufacture of glucose sugar."—Petitions recorded March 4, 1864.

556. Henry Cochrane, Ormesby Ironworks, Middlesborough-on-Tees, Yorkshire, "Improvements in moulds for casting metals."

562. Charles Humfrey, Suffolk Grove, Southwark, Surrey, "Improvements in vulcanising india-rubber."—Petitions recorded March 5, 1864.

568. William Edward Newton, Chancery Lane, London, "Improvements in refining sugar and molasses."—A communication from Louis Pierre Robert de Massy and Louis Robert de Massy, Rue St. Sébastien, Paris.—Petitions recorded March 7, 1864.

580. William Edward Newton, Chancery Lane, London, "Improvements in the manufacture or production of baryta and strontia."—A communication from Louis Pierre Robert de Massy and Louis Robert de Massy, Rue St. Sébastien, Paris.—Petitions recorded March 8, 1864.

582. Frederick Tolhausen, Boulevart Magenta, Paris, "Improvements in the manufacture of washing blues."—A communication from Madame Jobert, Dôle, France.

584. James Preston Worrall, Ordsall, Lancashire, "Certain improvements in dyeing or colouring looped cut pile or raised textile fabrics composed of cotton and silk."

586. George Davies, Serle Street, Lincoln's Inn, London, "Improved means of transforming the ebb and flow of the tide into a continuous and constant hydraulic power."—A communication from François Alfred Tallendeau, Nantes, France.

588. Felix Spiers and Christopher Pond, Princes Street, Cavendish Square, London, "Improvements in closing or stoppering bottles."—A communication from Barlow William Mallam, Melbourne, Victoria.

592. Edward Bishop, Headingly, near Leeds, and William Baily, Halifax, Yorkshire, "Improved means and apparatus for evaporating the water contained in fœcal or excrementitious matter."

594. Nathan Thomson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels, which improvements are also applicable to stopping the muzzles of fire-arms."

595. James Lee Norton, Belle Sauvage Yard, Ludgate Hill, London, "Improvements in the manufacture of manure, and in machinery to be used in this manufacture."

Notices to Proceed.

2903. John Kirkham, Euston Road, London, "Improvements in the treatment of certain ores of iron."

2913. James Seward, Clitheroe, and Henry Smith, Enfield, Lancashire, "An improved apparatus for preventing incrustation in steam boilers."

2931. Ferrar Fenton, Camberwell, Surrey, "Improvements in the treatment of vegetable fibres for the production of paper pulp or half stuff therefrom."

2949. George Wagstaff Yapp, Clement's Inn, Westminster, "Improvements in the preservation of animal substances."—A communication from Edward Gorges, Croisie, France.

2974. James Baker, Temple Street, Whitefriars, London, "Improvements in compositions applicable to the coating of ships' bottoms.

2981. Frederick Page, Birmingham, "Improvements in furnaces and apparatus for the manufacture of volatile hydro-carbons, which improvements are also in part applicable to furnaces and apparatus for the manufacture of illuminating gas."

2998. Samuel Smith and Thomas Smith, Fell Street, London, "Improvements in composition or means for the purpose of destroying insects by fumigation, and in means or apparatus employed therewith."—Petitions recorded November 27, 1863.

3009. Benjamin Jones, Warrington, Lancashire, "Improvements in separating sulphur from alkali waste."

387. Peter Armand Lecomte de Fontainemoreau, South Street, Finsbury, London, "Certain improvements in the manufacture of methylic ether and its application to the production of artificial ice."—A communication from Charles Tellier, Passy, near Paris.—Petition recorded February 15, 1864.

Do Vegetables Respire ?—The subject of vegetable physiology is very interesting, but intricate, many observers having given a great amount of time to the prosecution of inquiries in this branch of science, and much still remaining to be investigated. M. Mène, who has devoted his attention to the respiration of vegetables, has arrived at the following conclusions:—A plant can grow and flourish without taking in carbonic acid by its leaves. During the day time the plant does not evolve carbonic acid, nor take up all the carbonic acid, of the air in which it is placed. During the night and foggy days no absorption of carbonic acid takes place by the leaves. The amount of moisture transpired by the leaves depends more on the light than on the temperature. The carbonic acid set free from the leaves is the result of an elaboration by the roots. The amount of carbonic acid set free during the night is in proportion to the activity of vegetative life during the day. The great evaporation from the leaves seems to quite overthrow the idea of a vegetable respiration, that is, of an absorption of gas by the leaves, if the roots are acting normally.

CORRESPONDENCE.

Continental Science.

Paris, April 19.

At the scientific meeting of the Sorbonne, held on the 7th of this month, M. Pasteur treated of the subject of spontaneous generation. This conference is considered the grand triumph of the season. The importance of the subject in its bearing on other questions, such as that of the existence of the Deity, the eternal duration of matter, &c., was pointed out by the learned professor, who then put forth the various arguments in favour of and against the doctrine, showing the objections in a forcible manner, and altogether treating the subject with a masterly hand.

The following distribution of medals was made on the 10th of April at the Imperial and Central Society of Agriculture, his Excellence the Minister of Agriculture, &c., being in the chair :—Great medal of gold to A. M. and Madame Courade de Witt, for works on agricultural improvements effected on their domain; to M. Reiset, for works on agricultural improvements; to M. le Varonde Vaunce, for works on improvements in drainage and irrigation performed on the domains of Belleau; to M. Scipio Gras, for his geological and agricultural map of the department of L'Isére. Medal of gold to A. M. Maillebeau, to Dr. Jules Guyot, to M. Henrion Barbezant, to M. J. Beandouin, to M. Martin de Lignac, to M. Pichon, to M. Trépagne, to M. Théron de Montaugé, to M. Bataillard. Medal of silver to A. M. Théac.

The frequent occurrence of internal parasites in Algeria is noticed in *La Gazette Médicale* as having been observed by Dr. Baiseau. Soldiers are very apt to be attacked by these animals through drinking water which has not been filtered, and great difficulty is experienced in eradicating them. Vinegar and water or salt and water has been sometimes found successful, but it sometimes requires a long time before the animals can be dislodged.

At the Academy of Sciences of Vienna for the 17th March, a memoir was presented by M. Unger "*On a Species of Fossil Fern occurring very frequently in the Tertiary Strata.*" Portions both of the leaves and of the roots have been found.

M. Seligman made a verbal report on the skulls of different human races, which had been sent to him from Valparaiso by Dr. Aquinas Ried.

A bust of Daguerre of the natural size has been presented to the French Society of Photography. The bust was executed from photographs. M. Liebert placed before the Society enlarged prints obtained by means of the apparatus described at the previous meeting. M. Sabatier Blot described a new improvement which he has recently effected, in the construction of a chamber for operating in the country. He says the improvement consists principally in a regulator placed on the upper part of the frame for carrying the glass.

M. Morvan placed before the Society prints obtained by the process of which he has given the description. Several other gentlemen also exhibited prints by various processes. M. Delmas presented to the Society a seconds clock constructed by him for the use of photographers. In the bulletin of the Society there is also a note on the process of printing with ink from photographic images. The image is obtained by spreading a gelatinous or gummy film, containing bichromate of potash, on paper and placing it behind a negative. The light developes the drawing with change of colour. The print is then placed on the surface of water with the prepared side upward, the water soaks through the paper, and the parts unacted on become wet, while those coagulated by the light resist the passage of the water. The print is then pressed on a lithographic stone, which is moistened in those parts where the water has penetrated; the stone is then inked, and the remainder of the process conducted as usual. There is also a notice of recent modifications in the tannin process.

On Double Salts.

To the Editor of the Chemical News.

Sir,—A question has recently been raised among photographers as to the existence of the double chloride of gold and sodium. The objection put forth is a statement occurring in Fownes' "Chemistry," Ed. ix., p. 266, that double salts are never formed from bases taken from the same isomorphous family, and it is asserted that gold and sodium are isomorphous. The existence, however, of a double hyposulphite of gold and sodium would seem to be analogous in constitution to a double sulphide, one compound acting as acid and the other as base; or we may consider that hydrochloric acid under the joint influence of gold and sodium becomes polybasic, or that chloride of gold and hydrochloric acid combine together to form a compound acid $HAuCl_4$, in which the hydrogen can be replaced by other metals. There is no doubt as to the existence of the double salt, for it can be obtained in definite crystals, and the double salts of gold with organic bases are often employed to determine their equivalents, so that there is no doubt about their definite nature, and it does not at all follow that because chloride of sodium is sometimes found in excess in the commercial dry salt, or that because on solution in water common salt is left behind, there is no real combination, for it is possible that a double salt might be decomposed by water. There seems to be a regular gradation in the properties of these double salts, some of them approaching to the nature of salts of polybasic acids or of salts of compound acids, such as $HAuCl_4$, while others seem to be loose combinations of the two salts, which are held together by an attraction resembling that which holds the water of crystallisation to a salt, and between these two extremes there are intermediate stages. In fact, we may in some cases imagine a polybasic acid to be only polybasic when different bases are neutralised by it, the different bases causing the acid to assume a polybasic character, just as we may suppose gold and sodium to give to hydrochloric acid a polybasic character; for instance, employing the old equivalents and notation, there would be nothing inconsistent in the statement that in alum sulphuric acid is a quadribasic acid, the change being induced by the presence of the two bases; nor, on the other hand, in supposing tartaric acid to be monobasic, except when neutralised by two different bases. Such salts, however, as the double sulphates of iron and potash are at the other extremity of the series, these being apparently loose combinations of the two salts; while the gold salts are intermediate. The supposition in this case of a compound acid containing gold being formed is borne out by the analogy with the sulphur acids and salts; in fact, we should anticipate that there would be compounds intermediate in properties between bibasic and monobasic acids, no abrupt transitions being made in nature, and the bodies we have been considering supply this link.

There are reasons why bases from the same isomorphous group should not have a tendency to form double salts, for the isomorphous elements, being similar in properties in this respect, both want to occupy the same place in the compound; it is opposition of properties that tends to make a strong combination; and also, supposing a double salt to be formed, since one isomorphous element can replace another in a compound, the body might appear to have an indefinite composition. In the case of the double salts approaching polybasic acids in their character, it might still be that isomorphous bases were less likely to produce such compounds, for bodies not isomorphous might offer greater inducement to the acid to assume a polybasic character.

I am, &c. A. C. S.

March 30.

Radicle v. *Radical.*

To the Editor of the Chemical News.

Sir,—As you have allowed your correspondent "C. W. Q." to say a few words on the *radiculous* side of the dispute to which you have opened in your columns, perhaps you will be kind enough to grant me a short space for a reply.

If I do not mistake, it was Berzelius who first used the word *radical* to express what your correspondent and some others think is better expressed by *radicle*. Berzelius has been followed in the use of the word by most of the chemists since his time, by Gerhardt, by Laurent, not to mention living men, every one of whom, I imagine, was perfectly well acquainted with the French equivalent of *radicle*, and no doubt would have employed it if he had considered the word more appropriate. But is a diminutive a proper term to apply, say to cyanogen? Your correspondent says that cyanogen is the "little root" of the cyanogen compounds, which looks ridiculous. If radical be substituted by any other word, it should certainly be "root." I can imagine cyanogen the root of the cyanogen compounds, but cannot conceive of it as the "little root." But what advantage would there be in any alteration? The word radical is now perfectly well understood; its use has been consecrated by Time and great names, and why should we adopt any other term? If the innovators can give us any good reason for the change I shall be happy to follow them, but in the meantime I beg to subscribe myself yours, &c. A Radical.

MISCELLANEOUS.

Chemical Society.—Mr. Bassett requests us to state that the title of his paper read at the last meeting of the Chemical Society (see page 184) should have been "*On the Tetra-Basic Carbonate of Ethyl.*"

Radcliffe Travelling Fellowship, Oxford.—The Radcliffe Travelling Fellowship has been awarded to A. B. Northcote, B.A., of Queen's College. Mr. Northcote took a first-class in Natural Science in March Term, 1861.

Accidental Poisoning.—A lamentable occurrence happened in Liverpool a few days ago from the accidental substitution of strychnia for James' Powder. This could only have happened from the dangerous practice of keeping precipitated instead of crystallised strychnia in stock—dangerous for two reasons, the liability of the strychnia to adulteration, and the possibility of a substitution like that which was made.

A Davy Memorial.—A committee of the working men of Penzance having raised 500*l.* towards a memorial of the late Sir Humphry Davy, two ladies of that town—whose kindness to the poor is only equalled by their discriminating gifts—have offered to contribute 1000*l.*, on the sole condition that the memorial shall take the form of almshouses. Wednesday's *Cornish Telegraph* announces a further donation of 100*l.* by Mr. T. H. Bodilly, a merchant, of Penzance, and the proffered assistance of the London Chemical Society in securing for his natal place a memento of the distinguished chemist.—[We have authority for stating that this announcement, so far as regards the Chemical Society, is premature.]

Address to Convocation.—An address to Convocation is in course of signature among students of the natural sciences, which expresses a sincere regret that researches into scientific truth are perverted by some in our own times into occasion for casting doubt upon the "Truth and Authenticity of the Holy Scriptures." The following sentence, with which it concludes, expresses the object of the address:—"We therefore pray that the Bishops and Clergy in Convocation assembled, and of the Church of England, will do all in their power to maintain a harmonious alliance between Physical Science and Revealed Religion."

Black Dye for Kid Gloves.—Dissolve ten kil. of red chromate of potash in a sufficient quantity of hot water, and gradually add potash until the liquid no longer reddens litmus; then spread with a sponge, as a dye, this solution of chromate of potash on the skin. Besides this, there should be prepared, in a copper cauldron, a dye composed of one kil. of rasped fustic, ·750 kil. of fustic, one kil. of ground logwood, and three pailfuls of water; after being clarified this should be briskly boiled till there remains only two pailfuls of liquid, the rest being evaporated or absorbed by the wood. This dye is applied to the skin somewhat dried and mordanted with chromate of potash. The skin skould be spread out on a table and left till it attains the proper medium of dryness. It is then coated with a solution of one kil. of Marseilles soap, thick enough to form a kind of jelly, with which is mixed ·750 kil. of very pure colza oil, which should be so well incorporated as to have no drop of oil visible. This soap jelly frees the dyed skin from all humidity, and renders it supple, soft, and lustrous.—*Moniteur Scientifique*, v. 847.

Salicin in the Urine.—Dr. Landeren has found that when salicin is administered in considerable doses it passes away in the urine unchanged, and can be easily separated from the evaporated urine by means of alcohol. —(*Archiv. der Pharm.*, bd. c. xvi., s. 197.)

New Sounding Apparatus.—A new maritime sounding apparatus has recently been invented by M. Goüezel. A great objection to that at present employed is that currents in the water cause the line of suspension to be bent, and so the apparent depth, judged of by the length of line employed, is much greater than the real depth. The purpose to which the new sounder is intended to be applied is for the construction of a chart of the bottom of the ocean, which would be of immense service in the laying of telegraphic cables, and, apart from such uses, the possession of such a map would be of great scientific interest. In the improved apparatus the suspension line is altogether dispensed with; a rod of iron, furnished with nippers at the extremity, supports a cylindrical weight capable of being detached from the rod; above the weight a float of hollow metal is fixed. On striking the bottom of the water the weight is detached, and the remainder floats to the surface; a small clock enclosed in the apparatus is so arranged as to stop by the concussion, so that the time of descent can be estimated; a bell is also attached; an easily visible object is fixed above the whole, to avoid any difficulty in finding the apparatus after its arrival at the surface. The advantages of this apparatus for the purposes to which it is destined are so apparent that comment is unnecessary; close approximation to the real depth of the water at various parts of the ocean, with much more rapidity than with the old method, will now be obtainable, the friction of the line in the water retarding the descent to an immense extent.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

E. B.—It would take a page of the Chemical News to give you the details you ask. Refer to the last edition of Fresenius, p. 465.

W. G. S. W.—1. You are adopting the best method of purifying the naphtha. Distil from the brown deposit. 2. By dissolving hydrated alumina in hydro-fluoric acid, and evaporating the solution. The evaporation must be carried on in a metal dish. 3. We cannot advise. A chemist has sometimes great opportunities, but has often to submit to great disappointments.

M. S. C. E.—You will have to pass an examination in prescriptions, chemistry, materia medica, and pharmacy. The secretary, Mr. Brembridge, will give you all necessary information.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Thallium-iron-Alum, by WILLIAM CROOKES, *F.R.S., and Professor* A. H. CHURCH, *M.A.*

THIS salt was prepared and analysed nearly twelve months ago, and some crystals of it were then sent to Professor W. H. Miller, of Cambridge, for optical examination. Circumstances prevented the crystallographic characters of the salt coming to hand till recently, and, in the meantime, M. Nicklès* has published a brief account of the same salt.

Thallium-iron-alum readily crystallizes out when a solution of its component salts is evaporated. It forms large transparent crystals, having a faint amethystine colour, tolerably soluble in water, and fusible below 212° F.

The sulphuric acid was determined by dissolving in water, adding dilute nitric acid, and precipitating with nitrate of baryta. The iron was determined by precipitation with ammonia; and the water, by drying in an air-bath above 212°. The thallium was estimated by dissolving in a small quantity of hot water, adding an excess of strong hydrochloric acid, filtering, and washing, first with water, then with dilute alcohol.

9·4289 grains of substance gave 6·6435 grains of $BaO.SO_3$.

16·2802 grains of substance gave 1·9521 grains of Fe_2O_3.

8·2870 grains lost 2·6543 grains of HO.

17·6530 grains gave 6·2197 grains of TlCl.

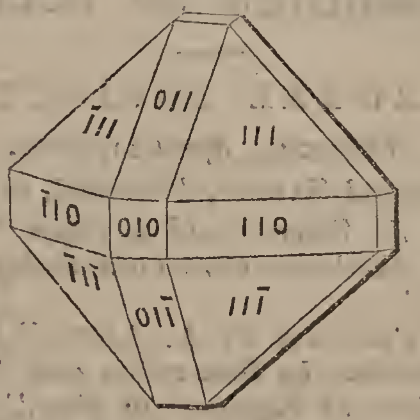
From these figures the following percentages are calculated:—

	Theory.	Experiment.
Tl	30·435	29·989
Fe_2O_3	11·994	11·991
SO_3	23·988	24·173
HO	32·384	33·147

Leading to the formula—

$$TlO.SO_3,Fe_2O_3,3SO_3,24HO.$$

We are indebted to the kindness of Professor W. H. Miller for the following observations regarding the crystalline form, &c., of the thallium-iron-alum:—



"Cubic.

Observed forms . 100, 111, 110.

Angles:—

111,	$\bar{1}11$ . . .	70° 32′
111,	010 . . .	54° 44′
111,	110 . . .	35° 16′
$\bar{1}11$,	$11\bar{1}$ . . .	109° 28′
010,	110 . . .	45° 0′
110,	011 . . .	60° 0′

"Cleavage:—1 1 1, distinct, but not very easily obtained.

"Index of refraction for the brightest rays of the solar spectrum = 1·469."

Perbromic Acid, by M. KAEMMERER.

PERBROMIC acid has been fruitlessly investigated by many chemists, but M. Kaemmerer has obtained it in the most simple manner by treating perchloric acid by bromine; chlorine is disengaged; the remaining liquid may be concentrated without danger in a water-bath to an oily consistence. In this state it is unalterable by sulphurous, hydrosulphuric, or hydrochloric acids, resembling in this respect its congeners, perchloric and per-iodic acids.

Perbromate of potash is more soluble than the perchlorate, and less so than the bromate.

Perbromate of baryta is a crystalline precipitate, very little soluble even in boiling water; it is the same with salt of lead; that of silver, on the contrary, dissolves abundantly in warm water; on cooling, it separates in strongly refracting needles.

The author suspects the new acid exists in the product of the distillation of bromic acid.—*Journ. für Prakt. Chemie*, xc., 190.

TECHNICAL CHEMISTRY.

A Method for Preserving the Colouring Matter of Litmus, by Dr. VOGEL.

IT is well known that litmus tincture so frequently used in analytical researches, alters progressively, even in a closed vessel, and losing its blue colour becomes yellowish brown. That this change of tint is the result, not of the destruction of the colouring matter, but of simple deoxidation, is shown by shaking the tincture in contact with the air, when the blue colour will reappear. Litmus dye, as M. Mohr has remarked, may be conveniently preserved in open, partly-empty flasks, the mouths being lightly plugged with cotton, simply to exclude dust. The author has found, nevertheless, that litmus dye, especially in a slightly concentrated solution, becomes, after a time, turbid and reddish. The latter phenomenon is probably due to the carbonic acid of the air, for on being boiled the liquid resumes its blue colour. M. Vogel now uses litmus dye made immediately before each experiment, with some litmus which he has found a means of preserving unaltered, and which he dissolves in water.

The preparation of this litmus is very simple. Take 16 grammes of commercial litmus, reduce it to a fine powder and put it into a cylindrical glass phial, with 120 cube centimetres of cold distilled water, and leave for twenty-four hours, taking care to stir occasionally. As the first portion of the liquid extract will contain all the free alkali of the litmus, it should be set aside, and on the residue should be poured a fresh quantity of 120 centimetres of distilled water; it should then again be left for twenty-four hours, and shaken at intervals. Then decant a second time, and divide the liquid into two equal parts, and stir one part with a glass tube dipped in diluted nitric acid, repeating the addition of this acid, by means of the tube, until the liquid becomes perfectly red. Then mix it with the other portion which has remained blue. The result is a reddish-blue liquid. A litmus dye is thus obtained as neutral as possible, which must then be evaporated in a porcelain capsule, placed in a sand-bath, and kept below boiling-point. There remains a granular, amorphous mass, which must be kept in a well-stoppered bottle. This matter dissolves in water, leaving no residue, and gives a lighter or darker blue according to the quantity of water used, and has the advantage of furnishing a litmus dye at a

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* *Journ. de Pharm. et de Chim.*, xlv., 24, 140.

moment's notice, and at any degree of concentration which may be required. If, for instance, it is desired to experiment with a standard solution, a piece of the above extract, about the size of a pin's head, put in a wine-glass containing a little water will yield a very convenient solution. This extract may be preserved in closed vessels for years without losing either its solubility or its blue colour.—*Journal de Pharmacie et de Chemie*, xlv. 70. 64.

PHARMACY, TOXICOLOGY, &c.

Case of Poisoning by Phosphorus.

The following is the chemical evidence in a case of poisoning by phosphorus. The viscera were taken to Dr. Herapath twenty days after the death of the infant, which had been buried for nearly that time. The history of the case and symptoms led to the suspicion of poisoning by phosphorus. Dr. W. B. Herapath detailed the chemical examination of the viscera, &c., which was as follows :—

"First, they were seriatim removed with great care on clean porcelain vessels to the interior of a photographic camera, and examined in the dark for evidence of luminosity. None presented itself, however, and the contents of the viscera were equally devoid of any such appearances. 2nd. The contents of the stomach were treated with pure ether. The etherial fluid decanted and filtered reduced the salts of gold and silver in such manner as a very minute trace of free or inflammable phosphorus would produce. The residual acid fluid was next tested by Mitscherlich's plan, by distillation with sulphuric acid, but without any corroborative evidence of the presence of phosphorus. 3rd. The same acid fluid was now tested by Scherer's distillation with zinc, and the evolved gas, chiefly hydrogen, passed through ammoniacal nitrate of silver; a black precipitate resulted, too minute in quantity to further test for phosphorus. This gave doubtful evidence of phosphorus existing as phosphorous acid in the contents of the stomach. 4th. The examination of the stomach's contents gave indications of phosphorus in the free state by the ether test, and probable evidence of phosphorous acid by Scherer's mode of testing for phosphuretted hydrogen. 5th. The whole intestines having been slit up for examination, the contents of the large intestine were carefully collected, amounting to two drachms of yellow pasty fæcal matter. This was first tested by Mitscherlich's process, but no evidence of phosphorus in the free condition resulted. The acid fluid produced was then tested by Scherer's process, as before, for phosphorus in the oxidised form of phosphorous acid; and the resulting black precipitate oxidised by nitric acid, and tested by a magnesian salt and ammonia. The characteristic crystals of phosphate of ammonia and magnesia were obtained, which proved the existence of phosphide of silver in the black precipitate, which probably arose from the presence of phosphorous acid in the contents of the rectum, cæcum, and colon in small quantity. 6th. The contents of the small intestines were also removed carefully and tested in the same way. Similar results were obtained, viz., the absence of free or combustible phosphorus, but the presence of phosphorous acid. 7th. One portion of the contents of the duodenum was tested by the tincture of iodine, for the presence of starch, but no blue reaction exhibited itself; whereas a reddish port wine colour was exhibited, which appeared to be due to the presence of dextrine, a substance into which starch is converted by digestion. 8th. In another portion of the contents of the small intestines, I endeavoured to destroy the organic matter of the fæces by nitric acid, and expected to find the Prussian blue, colouring matter, but failed in obtaining any. 9th. The whole of the stomach, small and large intestines, were dissolved in the dark by means of hydrochloric acid, absolutely pure; but no luminous appearances were exhibited: these phenomena would have been observed if a certain proportion of inflammable phosphorus had been present; it is a test nearly as good as Mitscherlich's. 10th. The acid solution, filtered from undissolved matters, were tested in a gas evolution bottle and with certain apparatus attached, which enabled me to test at one operation for arseniuretted hydrogen, antimoniuretted hydrogen, sulphuretted and phosphuretted hydrogen. There was negative evidence of the three former gases, but the black precipitate resulting was proved to be phosphide of silver, and therefore demonstrated the existence of an appreciable quantity of oxidised phosphorus existing in the tissues of the viscera as phosphorous acid; the same product as exists after the phosphorus paste has been exposed to the air. 11th. A large portion of the liver was dissolved and treated in a similar manner, by which a further quantity of phosphide of silver was obtained, from which crystals of phosphate, ammonia, and magnesia were obtained, and examined by the microscope. Results: Evidence of the presence of free phosphorus in minute quantity was obtained from the contents of the stomach; whilst evidence of phosphorous acid, the lower oxide of phosphorus, was obtained by Scherer's test, as modified by myself, from the contents of the stomach, and of the large and small intestines; whilst a still larger quantity of the same phosphorous acid was shown to have been absorbed or imbibed by the tissues of the stomach and intestines, and to be present in the liver; whilst the presence of dextrine in the intestinal canal shows that starch had been present there during life. I infer that phosphorus was probably the cause of the acute inflammation of the mucous surface of the stomach and intestines, of which the infant died."

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Thursday, April 21, 1864.

Major-General Sabine, *President, in the Chair.*

Professor H. J. Smith read a paper "*On the Orders and Genera of Quadratic Forms containing more than three Indeterminates.*"

A paper, by Professor F. A. Abel, F.R.S., "*On some Phenomena exhibited by Gun-cotton and Gunpowder under Special Conditions of Exposure to Heat,*" was then read. Being anxious to possess some rapid method of testing the uniformity of products obtained by carrying out General von Lenk's system of manufacture of gun-cotton, the author instituted experiments for the purpose of ascertaining whether, by igniting equal weights of gun-cotton of the same composition, by voltaic agency within a partially exhausted vessel connected with a barometric tube, he could rely upon obtaining a uniform depression of the mercurial column in different experiments made in atmospheres of uniform rarefaction; and whether slight differences in the composition of the gun-cotton would be indicated with sufficient accuracy by a corresponding difference in the volume of gas disengaged, or in the depression of the mercury. He found that, provided the mechanical condition of the gun-cotton, and its position with reference to the source of heat, were in all instances the same, the indications furnished by these experiments were sufficiently accurate for practical purposes. Each experiment was made with fifteen grains of gun-cotton, which were wrapped compactly round the platinum wire; the apparatus was exhausted until the column of mercury was raised to a height varying from 29 inches to 29·5 inches. The flash which accompanied the deflagration of the gun-cotton was apparently similar to that observed upon its ignition in open air; but it was noticed that an interval of time always occurred between the first application of heat (or incandescence of the wire) and the flashing of the gun-cotton, and that during this interval there was a very perceptible fall of the column of mercury. On several occasions, when the gun-cotton, in the form of "roving," or loosely-twisted strand, was only laid over the wire, so that it hung down on either side, the red-hot wire simply cut it into two pieces, which fell to the bottom of exhausted vessel without continuing to burn. As these results appeared to indicate that the effects of heat upon gun-cotton in a highly-rarified atmosphere differed importantly from those observed under ordinary circumstances, or in a very imperfect vacuum, a series of experiments, under variously modified conditions, was instituted, of which the following are some of the most important:—

About fifty different experiments were made with equal quantities of gun-cotton (0·2 grain), placed always in the same position, so that the platinum wire rested upon the material. A tolerably definite limit of the degree of rarefaction was arrived at, within which the gun-cotton was exploded instantaneously, as in the open air. When the pressure of air in the apparatus was reduced to 8·2 in inches of mercury, the gun-cotton still exploded with a flash, but not quite instantaneously; on reducing the pressure to eight inches, the cotton underwent a slow kind of combustion, attended with little or no flame, in the majority of cases; on a few occasions it exploded with a flash of flame. The same occurred in a succession of experiments, until the pressure was reduced gradually to 7·7 inches, when instances of the rapid explosion of gun-cotton were no longer obtained.

Although these results were moderately definite, when the conditions of the experiments were as nearly as possible uniform, it was found that they could be altered by slight modifications of any one particular condition (such as the quantity of gun-cotton, its mechanical condition, its position with reference to the source of heat, the quantity of heat applied, and the duration of its application).

For example, in one experiment the mass of cotton, exposed at one time to heat, was increased by doubling a piece of the twist (four inches long) and laying it thus doubled across the wire, as before. The current was allowed to pass until the wire was heated just sufficiently to ignite the gun-cotton, and then interrupted. In this case the slow combustion proceeded throughout the entire mass of the cotton. The permanent depression of mercury in this experiment was 0·6 inch. It was particularly noticed on this occasion that, as the decomposition of the gun-cotton crept slowly along the mass, the burning portions or extremities of twist were surrounded by a beautiful green light, more like a phosphorescence than a flame, and in form something similar to the brush of an electric discharge.

The various modifications in the nature and extent of combustion which gun-cotton may be made to undergo, as demonstrated by the above experiments, when exposed to heat in highly-rarefied atmospheres under variously modified conditions, are evidently due to the same causes which affect the rate of combustion of fuses under different atmospheric pressures, and which have already been pointed out by Frankland in his interesting paper on the influence of atmospheric pressure upon some of the phenomena of combustion. The heat furnished by an incandescent or melting platinum-wire is greatly in excess of that required to induce perfect combustion in gun-cotton which is actually in contact with, or in close proximity to, it; and the heat resulting from this combustion, which is contained in the products of the change, will suffice to cause the transformation of the explosion to proceed from particle to particle. But if the pressure of the atmosphere in which the gun-cotton is submitted to the action of heat be reduced, the gases resulting from the combustion of the particles nearest to the source of heat will have a tendency, proportionate to the degree of rarefaction of the air, to pass away into space, and thus to convey away from proximity to the cotton, more or less rapidly and completely, the heat necessary to carry on the combustion established in the first particles. Thus, when the heated wire is enveloped in a considerable body of gun-cotton, the ignition of the entire mass is apparently not instantaneous, if attempted in a highly-rarefied atmosphere, because the products of the combustion first established in the centre of the mass of gun-cotton escape rapidly into space, conveying away from the point of combustion the heat essential for its full maintenance; the gun-cotton therefore undergoes, at first, an imperfect form of combustion, or a kind of metamorphosis different from the normal result of the action of heat upon this material. But the effects of the gradual generation of heated gases from the interior of the mass of cotton are, to impart some of their heat to the material through which they have to escape, as well as gradually to increase the pressure of the atmosphere in the vessel, and thus to diminish the rapidity of their escape; hence, a condition of things is in time arrived at, when the remainder of the gun-cotton undergoes the ordinary metamorphosis, a result which is accelerated by maintaining the original source of heat. If, however, the gun-cotton be employed in a compact form (in the form of twist or thread), and placed only in contact with the source of heat at one point, the heat will be so effectually conveyed away by the escaping gases, that the material will only undergo even what may be termed the secondary combustion or metamorphosis, for a limited period; so that, if a sufficient length of gun-cotton be employed, it will after a short time cease to burn, even imperfectly, because the heat essential for the maintenance of any chemical activity is soon completely abstracted by the escaping gases. These results may obviously be modified in various ways, as shown in the experiments described; thus, by increasing and maintaining the source of heat, independent of the burning cotton, the slow combustion may be maintained through a much greater length of the material until the pressure of the atmosphere is increased, by the products disengaged, to an extent sufficient to admit of a more rapid and perfect metamorphosis being established in the remainder of the material; or the same result may be attained, independently of the continued application of external heat, by employing a thicker mass of cotton, or by using the material in a less compact form. In these cases the maintenance of the chemical change is favoured either by radiation of heat to the cotton, and provision of additional heat, from an external source, to the gases as they escape and expand; or by establishing the change in a greater mass of the material, and thus reducing the rapidity with which the heat will be conveyed away by the escaping gases; or, finally, by allowing the gases, as they escape, to pass to some extent between the fibres of the cotton, and thus favouring the transmission of heat to individual particles of the material.

From other experiments made in a darkened room, it appeared that gun-cotton, when ignited in small quantities in rarefied atmospheres, may exhibit, during its combustion, three distinct luminous phenomena. In the most highly rarefied atmospheres, the only indication of combustion is a beautiful green glow or phosphorescence which surrounds the extremity of the gun-cotton as it is slowly transformed into gases or vapours. When the pressure of the atmosphere is increased to one inch (with the proportion of gun-cotton indicated), a faint yellow flame appears at a short distance from the point of decomposition; and as the pressure is increased, this pale yellow flame increases in size, and eventually appears quite to obliterate the green light. Lastly, when the pressure of the atmosphere, and consequently proportion of the oxygen in the confined space, is considerable, the cotton burns with the ordinary bright yellow flame. There can be no doubt that this final result is due to the almost instantaneous secondary combustion, in the air supplied, of the inflammable gases evolved by the explosion of the gun-cotton. It was thought that the pale yellow flame described might also be due to a combustion (in the air still contained in the vessel) of portions of the gases resulting from the decomposition of the gun-cotton; but a series of experiments, in which nitrogen, instead of air, constituted the rarefied atmosphere, showed that this could not be the case. The results obtained in these experiments corresponded closely to those above described, as far as relates to the production of the green glow and of the pale yellow flame. With rarefied atmospheres of nitrogen, ranging down to one inch of pressure, the green flame was alone obtained, and the pale yellow flame accompanying the green became very marked at a pressure of three inches, as in the experiments with air.

It would seem probable from these results that the mixture of gaseous products obtained by the peculiar change which heat effects in gun-cotton in highly rarefied atmospheres, contains not only combustible bodies, such as carbonic oxide, but also a small proportion of oxidising gas (possibly protoxide of nitrogen, or even oxygen), and that, when the pressure in the atmosphere is sufficiently great, this mixture, which has self-combustible properties, retains sufficient heat as it escapes to burn, more or less completely, according to the degree of rarefaction of the atmosphere.

A series of experiments instituted with gun-cotton in highly rarefied atmospheres of oxygen showed that the additional proportion of this gas thus introduced into the apparatus, beyond that which would have been contained in it with the employment of air of the same rarefaction, affected in a very important manner the behaviour of the explosion under the influence of heat. If eight or ten grains of gun-cotton are placed round the platinum wire, and the pressure of the atmosphere of oxygen in the vessel be reduced to four or three (in inches of mercury), the cotton explodes instantaneously with an intensely bright flash, when the wire is heated. In a series of experiments made under gradually diminished pressures, oxygen being used instead of air, it was found that the gun-cotton exploded instantaneously with a bright flash until the pressure was reduced to 1·2 inch; from this pressure to that of 0·8 inch it still burned with a flash, but not instantaneously; and at pressures below 0·8 inch it no longer burned with a bright flash, but exhibited the comparatively slow combustion, accompanied by the pale yellow flame, which has been spoken of as observed when gun-cotton was ignited in air rarefied to pressures ranging from one inch to twenty-four inches.

The interesting phenomena exhibited by gun-cotton in highly rarefied atmospheres induced the author to make some experiments of a corresponding nature with gunpowder. The same apparatus was used as in the preceding experiments, but a small glass cup was fixed immediately beneath the platinum wire, so that, by bending the latter in the centre, it was made to dip into the cup, and could be covered by grains of gunpowder.

Two grains' weight of small grain gunpowder were heaped over the wire, and the pressure of air in the apparatus was reduced to 0·65 inch. The wire being heated to redness, three or four grains, in immediate proximity to it, fused in a short time and appeared to boil, evolving yellowish vapours, no doubt of sulphur. After the heat had been continued for eight or ten seconds, those particular grains deflagrated, and the remainder of the powder was scattered by the slight explosion, without being ignited. No appreciable depression of the mercurial column occurred during the evolution of the yellowish vapours; the permanent depression, after the deflagration, was only 0·15 inch.

A single piece of gunpowder, weighing fourteen grains, so shaped as to remain in good contact with the wire, was placed over the latter, being supported by the cup. The pressure of air in the apparatus was, as before, equal to 0·65 inch of mercury. There was no perceptible effect for a short time after the wire was first heated to redness; vapours of sulphur were then given off, and slight scintillations were occasionally observed; after a time the wire became deeply buried in the superincumbent mass of gunpowder, which fused and appeared to boil where it was in actual contact with the source of heat. After the lapse of three minutes from the commencement of the experiment, the powder deflagrated. The permanent depression of the mercury column amounted to 1·35 inch.

The experiments were continued with fine-grained gunpowder, and under pressures gradually increased, in successive experiments, from ·07 to 3, in inches of mercury. The same weight of gunpowder (four grains) was used in all the experiments. In those made under a pressure of one inch, the results observed were similar to those obtained in the first experiment. At a pressure of three inches, no grains were ignited singly; the combustion of the powder was effected after an interval of about four seconds, and the greater portion was burned, the combustion becoming more similar to that of gunpowder in open air, but still very slow.

Experiments made with gunpowder in highly rarefied atmospheres of nitrogen furnished results quite similar to those described; nor was any important difference in the character of the phenomena observed when oxygen was substituted for air, except that the scintillations and deflagrations of the powder-grains were in some instances somewhat more brilliant.

The above experiments show that when gunpowder is in contact with an incandescent wire in a highly rarefied atmosphere, the heat is, in the first instance, abstracted to so great an extent by the volatilisation of the sulphur that the particles of powder cannot be raised to the temperature necessary for their ignition until, at any rate, the greater part of that element has been expelled from the mixture, in consequence of which the portions first acted upon by heat will have become less explosive in their character, and require, therefore, a higher temperature for their ignition than in their original condition. The effect of the continued application of heat to the powder thus changed is, to fuse the saltpetre and to establish chemical action between it and the charcoal, which, however, only gradually and occasionally becomes so energetic as to be accompanied by deflagration, because the gas disengaged by the oxidation of the charcoal continues to convey away much of the heat applied, in escaping into the rarefied space. For the same reason, the grains of unaltered powder which are in actual contact with the deflagrating particles are not ignited by the heat resulting from the combustion, but are simply scattered by the rush of escaping gases, at any rate until the pressure in the vessel has been so far increased by their generation as to diminish the rapidity and extent of their expansion at the moment of their escape. The disengagement first of sulphur-vapour and then of gaseous products of chemical change, unattended by phenomena of combustion, when gunpowder is maintained in contact with a red-hot wire in very highly rarefied atmospheres, are results quite in harmony with the observations made by Mitchell, Frankland, and Dufour with regard to the retarding influence of diminished atmospheric pressure upon the combustion of fuses. There is no doubt that the products of decomposition of the gunpowder, obtained under these circumstances, differ greatly from those which result from its exclusion in confined spaces or in the open air under ordinary atmospheric conditions. In all the experiments conducted in the most highly rarefied atmospheres (at pressures of 0·5 to 1·5 in inches of mercury), the contents of the vessel, after the final deflagration of the powder, always possessed a very peculiar odour, similar to that of horse-radish, and due to the production of some sulphur compound. Nitrous acid was also very generally observed among the products.

(To be continued.)

CHEMICAL SOCIETY.

Thursday, April 21, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the last ordinary meeting were read and confirmed, Mr. Benjamin C. Staples and Mr. Thomas L. G. Bell, having been recently elected, were formally admitted as Fellows of the Society. The members then proceeded to ballot for Mr. James Mactear, Buchanan Street, Glasgow; Mr. George Ward, Leeds; Mr. John Dowling, Dublin, all of whom were duly elected as Fellows; and the foreign members proposed by the council, viz., MM. Dessaignes, Erdmann, and Von Fehling, were likewise unanimously elected.

The President regretted the necessity of having to announce that the sudden illness of Professor J. T. Way would prevent that gentleman addressing the meeting on an agricultural subject of great interest, as he had promised to do; he hoped, however, that Mr. Way's indisposition was not so serious but that he would shortly be able to fulfil his promise. Under these circumstances he would ask Professor Wanklyn to favour the Society with a communication "*On the Hexyl Group.*"

Professor Wanklyn commenced by stating that the results he was about to describe had been worked out conjointly by Dr. Erlenmeyer and himself, and that they were to be taken as a continuation of the researches presented last year to the Society (*vide Jour. Chem. Soc.*, Ser. 2, Vol. I., p. 221). Referring to the advantages of the mode of preparing β iodide of hexyl by the action of hydriodic acid upon mannite, the authors state that they commonly obtain a product equal to 90 per cent. of the theoretical amount. By the action of alcoholic potash on this iodide it was not possible to obtain any appreciable amount of the β hexylic alcohol; the result of this action was hexylene and hydriodic acid, as shown in the following equation:—$C_6H_{13}I = C_6H_{12} + HI$. Small quantities of hexylic alcohol were, indeed, formed, but no practical use could be made of the reaction, since one experiment furnished more than 75 per cent. of the theoretical yield of hexyline, according to the above equation; showing, therefore, but a trifling balance available for the production of the alcohol. The action of sulphide and sulphydrate of potassium upon the iodide did not liberate any hexyline, but formed at once a mercaptan. The author had studied the action of dry hydrochloric acid upon the β hexylic alcohol. The gas was passed into the alcohol to saturation, and the mixture was then heated in sealed tubes to 100° C. Two layers were formed, of which one consisted of aqueous hydrochloric acid. This being removed, the liquid was treated again with dry hydrochloric gas, and again heated under pressure, when the desired combination was completely effected. The product had a boiling point between 120° and 130° C.; and its combustion with chromate of lead afforded numbers which nearly agreed with theory; but there was still a little free alcohol contained in the substance. An attempt to prepare the acetate by digesting the β alcohol with glacial acetic acid was not successful; for after prolonged treatment a trace only of the desired compound was found; but by employing the ready-formed β hexyl-sulphuric acid (described in the former memoir at page 232) the true acetate was easily prepared. One part of hexyl-sulphuric acid digested with eight parts of glacial acetic acid, and subsequently distilled, furnished the pure acetate with liberation of sulphuric acid according to the following equation:—

$$\left.\begin{matrix}C_6H_{13}\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O = \left.\begin{matrix}H\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}C_2H_3O\\C_6H_{13}\end{matrix}\right\}O.$$

The acetate boils at 155°—157° C., and is so stable that an exposure for twelve hours to the temperature of 200° C. did not alter the character of the substance in the slightest degree. Alcohol potash decomposes it in a perfectly different manner to that described in the case of the β iodide of hexyl; for not a trace of hexylene was formed. The β alcohol, when acted upon by sodium, furnished a double compound, which has yet to be fully examined. The preparation of β hexyl-mercaptan, already alluded to, was in the next place more minutely described. It appears to be the sole product of the action of sulph-hydrate of potassium upon the β-alcohol. This body combines readily both with the red oxide and the perchloride of mercury. The boiling point was observed to be 142° C. under a pressure of 760 mm. Its odour was similar to the other mercaptans, but not persistent. It combines both with solid and aqueous potash; but on gently heating the solution an oily layer separates out which remains to be further examined. The author showed an experiment which demonstrated the facility with which the potash solution of β hexyl-mercaptan underwent a change by the application of a moderate heat. The sealed tube, at first perfectly transparent, soon became turbid, and allowed an oil to separate. Sodium evolves hydrogen from the mercaptan, and forms a white solid body.

The President, in moving a vote of thanks to Professor Wanklyn, pointedly referred to the interesting and important difference noticed by the author in the reactions of potash upon the acetate and the iodide of hexyl.

In reply to Dr. Odling, the Author explained that the product of the decomposition of the acetate had all the properties of the β alcohol; and in answer to Dr. Hofmann, stated that he had not yet fully examined the action of ammonia on the β iodide of hexyl, but, so far as he could affirm at present, there appeared to be much hexylene liberated and but a trace of alkali formed.

Dr. Hofmann stated that Professor Wurtz, in operating upon the β iodide of amyl, found that digestion with ammonia disengaged much amylene, and gave rise to the production of a basic body, which was not, however, the ordinary amylamine.

Dr. Frankland having inquired about the optical properties of the α and β hexylic alcohol,

Professor Wanklyn said he had not yet found an opportunity of examining their action upon light.

After a few remarks having reference to the theoretical constitution of bodies in this class and other series closely related.

The President requested Dr. Redwood to read a communication from Professor R. V. Tuson, descriptive of the alkaloids he had discovered in castor and croton seeds.

The author commenced by referring to the importance to be attached to the study of plants of the genera *Euphorbiaceæ*, which had furnished many valuable medicinal remedies. Although the oils expressed from castor and croton seeds had been so long employed in medicine, the isolation of their active principles had not yet been accomplished. The experiments about to be detailed had resulted in the identification of a new organic alkaloid, to which the author applied the name *Ricinine*. For the preparation of this substance the following method was adopted:—The crushed castor seeds were exhausted with water, the aqueous solution being filtered and evaporated over a water bath. The residue was then treated with boiling alcohol and allowed to cool, in order that certain resinous impurities might separate, then filtered, the solution partially evaporated and allowed to stand at rest for some time, when the impure ricinine crystallised out. The crude product was then purified by solution in alcohol and digesting with animal charcoal. The substance then took the form of rectangular prisms and plates, colourless, and having a feebly bitter taste, somewhat like that of the oil of bitter almonds. It may be sublimed with trifling loss. Heated on platinum foil, it melts and burns with a fuligenous flame. Water and alcohol dissolve ricinine, but it is insoluble in ether and benzol. Nitrogen is an elementary component, since the pure substance gives off ammonia on heating with caustic potash. It dissolves apparently without alteration in concentrated sulphuric acid. Hot and cold nitric acid likewise dissolve it without production of red vapours, and on evaporation furnish (a nitro-compound ?) in colourless, acicular crystals. Hydrochloric acid forms with it a salt which is prone to decomposition during evaporation. When to the aqueous solution of this hydrochlorate is added bichloride of platinum no precipitate is formed, but upon slowly evaporating the mixture very definite orange octohedra crystallise out. The cold saturated solution becomes quite solid on mixing with perchloride of mercury from the formation of beautiful silky crystals of the double salt, which were exhibited. By the action of water on castor oil itself, the author had extracted ricinine perfectly similar to that obtained from the crushed seeds. The administration of two grains of the new alkaloid to a rabbit was not followed by any distressing symptoms; it was neither poisonous nor aperient. By a similar process the author extracted from croton seeds a crystalline organic principle very like cascarilline, but there were differences observed in their comportment with sulphuric and hydrochloric acids.

The PRESIDENT moved a vote of thanks to Professor Tuson for his interesting communication. If he had rightly understood the author's statement, it appeared that the basic substance which he had succeeded in separating from castor and croton seeds was not the purgative principle, but a less active ingredient, which, however, deserved fuller investigation.

Dr. ODLING then read a paper, by Professor A. KEKULÉ, entitled "*On the Action of Hydrobromic Acid and of Hydriodic Acid upon Polyatomic Acids, and on the Behaviour of the Iodo-substitution Compounds towards Hydriodic Acid.*" The author believed that the atomicity of the organic acids was a more important consideration than their basicity, and that in reviewing their theoretical constitution it was possible to conceive hydrogen as existing in three distinct forms of combination; thus, the hydrogen may belong to the radical according to the requirement of the theory of types; or, secondly, the hydrogen may be substituted by metals (hydrogen of acids); or, thirdly, it cannot be replaced in this manner (hydrogen of alcohols). Those polyatomic acids whose basicity is less than their atomicity are to be ranked, with respect to the nature of the typical atoms of hydrogen, between the alcohols and those organic acids whose basicity is equal to their atomicity. The primary cause of these differences must be looked for in the nature of those atoms which surround, or are associated with, the respective hydrogen atoms; thus it would appear that the chemical nature of the space ordinarily occupied by the hydrogen atoms must be the resultant of all the forces of attraction which the various atoms surrounding this space can exercise. With respect to the constitution of glycolic acid and some other polybasic acids, whose basicity is less than their atomicity, and in which the typical atoms of hydrogen are not precisely of the same value, the author considered that they behave as though one side of the molecule were composed of an alcohol, and the other of an acid. In proceeding to support these theoretical views by facts, the author mentioned the circumstance that the alcohols give rise to the production of chlorides and bromides when acted upon by hydrochloric or hydrobromic acid, thus,—

$$C_2H_6O + HBr = H_2O + C_2H_5Br;$$

whereas with acids the reaction is inverted, *i.e.*, the chloride or bromide undergoes decomposition by water; for example:—

$$C_2H_3OBr + H_2O = HBr + C_2H_4O_2.$$

If, now, in glycolic acid and lactic acid one side of the molecule behaves like an alcohol, these acids ought to undergo the same transformation as the alcohols by the action of hydrobromic acid, forming bromides with elimination of water. These bromides are known to be identical with the bromine substitution products of acetic acid and propionic acid; the same bodies ought, therefore, to be produced as kinds of ethers from glycolic acid and lactic acid.

1. $C_2H_4O_3 + HBr = H_2O + C_2H_3BrO_2.$
2. $C_3H_6O_3 + HBr = H_2O + C_3H_5BrO_2.$

In a similar manner the bibasic, triatomic, malic acid should furnish bromo-succinic acid, thus—

$$C_4H_6O_5 + HBr = H_2O + C_4H_5BrO_4.$$

and the bibasic, quadratomic tartaric acid (containing two alcoholic hydrogen atoms), in like manner the bibromo-succinic acid—

$$C_4H_6O_6 + 2HBr = 2H_2O + C_4H_4Br_2O_4.$$

The author, in the next place, described the results of several experiments upon glycolic, lactic, and malic acids which generally supported these views. In proceeding to discuss the nature of the action of iodine upon iodo-substitution compounds, the author pointed out certain differences in the behaviour of chlorine and bromine on the one hand, and of iodine, which are easily accounted for by the varying degrees of affinity which these elements possess for hydrogen. Referring, then, to the iodo-substitutes, he found that iodo-acetic acid (prepared according to the process of Perkin and Duppa), was easily decomposed by fuming hydriodic acid with liberation of iodine; likewise the iodo-propionic acid of Beilstein was similarly affected at a higher temperature, with regeneration of the acids—

1. $C_2H_3IO_2 + HI = C_2H_4O_2 + I_2.$
2. $C_3H_5IO_2 + HI = C_3H_6O_2 + I_2.$

In the event of this action of hydriodic acid upon the iodo-substitution compounds of organic acids being proved to be a general reaction, it is evident that such substitution compounds can never be formed directly by the action of iodine upon organic acids. When iodo-salicylic acid was heated with hydriodic acid it was found that much free iodine was liberated, and that salicylic acid was regenerated according to the equation—

$$C_7H_5IO_3 + HI = C_7H_6O_3 + I_2.$$

This observation tended to cast doubt upon the assertions of Kolbe and Lautemann, whose experience was stated to be directly contrary. It was possible, however, to induce the formation of iodo-salicylic acid by the intervention of an alkali, and the following equation was true—

$$C_7H_6O_3 + I_2 + KHO = C_7H_5IO_3 + H_2O + KI.$$

Under these circumstances, a red body of the formula—

$$C_6H_2I_2O$$

was always formed, as had been previously noticed by Lautemann. The presence of iodic acid was found to assist the action of iodine upon these organic acids. When applying the hydriodic acid to the reduction of the polyatomic acids, the author found no difficulty in converting glycolic acid into acetic acid. There were probably two stages in the reaction, the second of which was a kind of retrograde substitution. The conversion of glycolic into acetic acid might be shown by the following equations—

$$C_2H_4O_3 + HI = H_2O + C_2H_3IO_2.$$
$$C_2H_3IO_2 + HI = I_2 + C_2H_4O_2.$$

The author considered these reactions might be applicable in a great number of similar instances, several of which were indicated in the concluding paragraph of his communication, and to the elucidation of some of these points his experiments were now being directed. He conceived the following reactions to be possible—

$$1.\ \underset{\text{Iodoform.}}{CHI_3} + HI = I_2 + \underset{\text{Iodide of Methylene.}}{CH_2I_2}.$$

$$2.\ \underset{\text{Iodide of ethylene.}}{C_2H_4I_2} + HI = I_2 + \underset{\text{Iodide of ethyl.}}{C_2H_5I}.$$

$$3.\ \underset{\substack{\text{Iodide of}\\ \text{ethylene.}}}{C_2H_4I_2} + \underset{\substack{\text{Iodide of}\\ \text{methyl.}}}{CH_3I} = I_2 + C_2H_4\,(CH_3)\,I = \underset{\substack{\text{Iodide of}\\ \text{propyl.}}}{C_3H_7I}.$$

$$4.\ \underset{\substack{\text{Iod acetic}\\ \text{acid.}}}{C_2H_3IO_2} + \underset{\substack{\text{Iodide of}\\ \text{methyl.}}}{CH_3I} = I_2 + C_2H_3\,(CH_3)O_2 = \underset{\substack{\text{Propionic}\\ \text{acid.}}}{C_3H_6O_2}.$$

The President could not give his assent to all the propositions stated in the interesting communication of Professor Kekulé. The distinction between alcohol-hydrogen and basic hydrogen was, he considered, unnecessary, and not supported by fact; aud the speculations regarding the existence of spaces around the atoms of hydrogen were not good in theory.

Mr. Perkin stated that he had already published in the Chemical News* some three or four years ago an account of the conversion of brom-acetic acid into lactic ether, and several particulars relating to glycolic and lactic acids, which were now brought forward as newly-ascertained facts.

Professor Wanklyn had made experiments on the action of hydriodic acid upon the bromide and iodide of ethylene, and found that iodine was liberated, and, in fact, that the reaction which Professor Kekulé now speculated upon was already ascertained to be true.

Dr. Hofmann stated that he had listened with great interest to the important developments in Professor Kekulé's paper, more especially to those which had reference to the action of hydriodic acid upon iodo-substitutes. The action of hydriodic acid upon iod-acetic and iodo-propionic acids was perfectly analogous to that of hydriodic acid upon iod-aniline, a detailed account of which he had laid before the Society at one of their meetings in the last month.†

$$\underset{\text{Iod-aniline.}}{C_6H_6IN} + HI = \underset{\text{Aniline.}}{C_6H_7N} + II.$$

$$\underset{\text{Iod-acetic acid.}}{C_2H_3IO_2} + HI = \underset{\text{Acetic acid.}}{C_2H_4O_2} + II.$$

But he had gone even further, and shown that by employing, instead of hydriodic acid, hydriodic ether (iodide of ethyl) the radical ethyl might be substituted for the iodine contained in iod-aniline, which was thus easily converted into ethylaniline.

$$\underset{\text{Iod-aniline.}}{C_6H_6IN} + C_2H_5I = \underset{\text{Ethylaniline.}}{C_6H_6\,(C_2H_5)\,N} + II.$$

If he took this opportunity of reminding the Society of these experiments, he was far from wishing to diminish the value or the originality of Professor Kekulé's observations, who had obviously been led to similar results quite independently, and unacquainted with the experiments just quoted. But Professor Kekulé having at the conclusion of his paper expressed his intention to pursue this inquiry, and to examine the action of iodide of ethyl upon iodo-substitutes, he (Dr. Hofmann) considered it desirable, by reminding the Society of the results he had laid before them, to reserve for himself the right of further elaborating a reaction which he had been the first to point out. The speaker then mentioned that the effect of hydriodic acid upon iodo-substitutes was readily traceable in the preparation of iod-aniline and similar substances. The best result was always obtained by employing a quantity of iodine sufficient only to iodinate half the amount of base, so as to eliminate the hydriodic acid generated in the form of hydriodate of aniline.

$$\underset{\text{Aniline.}}{C_6H_7N} + 2I = \underset{\text{Iodaniline.}}{C_6H_6IN} + \underset{\text{Hydriodate of aniline.}}{C_6H_7N,HI}$$

The same observation applied to the preparation of iodo-toluidine, C_7H_8IN, a base of remarkable beauty, which he had obtained during the last few days. In conclusion, Dr. Hofmann remarked that the formation of diniodide of methylene from iodoform by simple exposure to heat, which he had pointed out some years ago to the Society,‡ was no doubt a secondary product of the action of hydriodic acid, separated during the destruction of one portion upon another portion of the iodoform not yet decomposed. Large quantities of iodine were separated in this reaction. The results thus obtained might be considered as an experimental anticipation of the suggestion thrown out by Professor Kekulé, that the action of hydriodic acid upon iodoform would probably give rise to the formation of diniodide of methylene.

The President was happy in being able to announce to the meeting the pleasing intelligence that Sir Benjamin Brodie had so far recovered from the effects of his recent accident that he would be prepared to address the Society at its next meeting on May 5, when he would deliver his promised lecture "*On the Organic Peroxides Theoretically Considered.*" The meeting was then adjourned until that date.

PHARMACEUTICAL SOCIETY.

April 20.

Dr. Attfield continued his criticism of the Pharmacopœia, with the view of showing how far the authors had succeeded in representing the advancement which has been made in pharmaceutical science since the publication of the last Pharmacopœias. Resuming the consideration of the Liquors, the lecturer remarked that since the object of publishing a pharmacopœia is the instruction of the apothecary and pharmaceutist rather than the manufacturer, it was to be regretted that the simple process suggested by Professor Redwood for the preparation of liquor potassæ had not been introduced. This process consists in simply shaking together in water carbonate of potash and an excess of slaked lime. In this way a purer solution is obtained than by the Pharmacopœia process. Noticing the Misturæ, Dr. Attfield observed that the addition of glacial acetic acid to dissolve the creosote in misturæ creosoti seemed unnecessary, since Pereira asserted that one part of creosote will dissolve in eighty parts of water, and in the mixture one part of creosote is ordered with 440 of water. Speaking of misturæ ferri, he regretted that bruised myrrh was not ordered in place of the powder, inasmuch as it has been shown that a much more elegant mixture is made when the myrrh is carefully rubbed down. Passing to the Pilulæ, Dr. Attfield referred to the experiments of Mr. Tyson, an excellent pharmaceutist, as well as medical practitioner, who long ago pointed out that a much more efficacious pilula hydrargyri is made by employing the protoxide instead of metallic mercury. Mr. Tyson's formula was as follows:—

Hydrargyri protoxidi, ℥j.;
Conf. rosæ gall, ʒiij.;
Pulv. flor. anthem, ʒss. M.

This pill, containing only half the quantity of mercury, Mr. Tyson said was the same colour as blue pill, far superior to it, always certain, and made in a few minutes. The difficulty was in getting a slate-coloured protoxide, but the author showed that this could always be obtained by treating calomel with liquor potassæ and a little ammonia.

Many have asked the use of hydrochloric acid in the precipitation of podophyllum resin. Dr. Attfield explained that the object was the precipitation of hydrochlorate of *berberine* (not beberine), which is present in podophyllum, and is supposed to contribute to the action of the drug. Referring to potassæ permanganas, the lecturer observed

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* *Vide* Chemical News, vol. iii., p. 81.

† *Vide* Chemical News, p. 163 of present volume.

‡ *Journal of the Chemical Society*, XIII., 65.

that the process of Böttger, already given in the Chemical News, is preferable to that of the Pharmacopæia, since it excludes the possibility of having the permanganate contaminated by the presence of sulphate of potash. The roundabout process for preparing neutral sulphate of potash from the bisulphate was next noticed, and Dr. Attfield pointed out that it is quite sufficient to add carbonate of potash until effervescence ceased, and then evaporate and crystallise. The form for antimonial powder the lecturer regarded as a feature in the Pharmacopœia. It is identical with that recommended as early as 1842 by the Mr. Tyson already referred to. He made many analyses and many physiological experiments, and came to the conclusion that there were only two antimonial preparations worthy of notice—the tartrate and the oxide. At length he devised the mixture of oxide and phosphate of lime, such as we have in the British Pharmacopœia, which, writing in 1842, he expressed a great wish to see introduced into the London Pharmacopœia. We pass by the lecturer's notice of the powders. Coming to quinæ sulphas, he remarked that, in testing the purity of this salt by the directions given, "pure" ether cannot be employed, since the amount stated is not sufficient to take up all the quina. The officinal ether will answer, and the word "pure" should have been omitted. Referring to santonin, Dr. Attfield pointed out that no test for the presence of strychnia is given in the Pharmacopœia. A case is recorded in which a fatal result followed the administration of santonin, which was afterwards found to contain strychnia. Speaking of sodæ arsenias, the lecturer observed that if this salt is prescribed in pills, the substance which ought to be dispensed is the salt with 14 atoms of water, and not the anhydrous salt which is used for the preparation of the liquor; and, therefore, prescribers must remember that the former contains only 37 per cent. of arsenic acid, while the latter contains nearly 62. Sodæ carbonas exsicatta, Dr. Attfield thinks, should have been ordered to be prepared from the bicarbonate in accordance with the recommendation of several pharmaceutists. This yields a white, pulverulent, easily-soluble monocarbonate, superior in every respect to the hard cake formerly obtained by heating the carbonate to redness. In speaking of the new formula for spiritus ammoniæ aromaticus, the lecturer mentioned that the recommendations of some pharmaceutists have been carried out in the Pharmacopœia. The form for syrupus ferri phosphatis is nearly identical with that given by Mr. Gale. (See vol. i., p. 270, Chemical News.) The use of granulated sulphate of iron Dr. Attfield regards as an unnecessary refinement. Each drachm of the syrup contains one grain of phosphate of iron ($3FeOPO_5$) and twenty-five minims of diluted phosphoric acid. The lecturer next referred at some length to the tinctures, and quoted the experiments of Burton, who determined how long it took to exhaust the materials of many tinctures when they were suspended in a bag at the upper part of the menstruum. The results showed that forty-eight hours sufficed for most tinctures, the exceptions being those which the British Pharmacopœia orders to be macerated for a longer period, *e.g.*, tinct. opii. and assafœtidæ, and some others. Dr. Attfield, however, suggested that the subject still required further investigation, which would probably result in the discovery of improved processes for each tincture. In making tinct. quinæ, it was pointed out that the whole of the quinine may be dissolved by digesting for a time at 90° to 100°. The deposit which sometimes forms, Mr. Henningway states, is caused by the orange peel, which is found to vary in nature.

Unguentum hydrarygri, Dr. Attfield stated, should be prepared at once from the black oxide, according to the recommendation of Mr. Tyson, since it has been shown that metallic mercury is incapable of permeating living tissue, and, therefore, the efficacy of the ointment must be entirely owing to the black oxide it contains. The process for ung. hydrarg. nitratis he commended. The form for vinum ferri is of doubtful value, since a deposit soon occurs, and the strength of the new wine is as uncertain as that of the old. An iron wine of constant strength and appearance is still needed.

In conclusion, Dr. Attfield remarked that although the fusion of the three Pharmacopœias into one must be considered to have been accomplished in a most satisfactory manner, and be a source of congratulation to all, yet it is open to serious question whether the compilers of the work have accurately represented the advancement made in pharmacy during the past thirteen years. The comments made and published show that while the materia medica part of the book may be regarded as a success, the preparations and compounds are, to a great extent, a failure. Such a result may be fairly ascribed to want of pharmaceutical co-operation in the work of compilation. Had the book been thrown open to comment before publication instead of after, or the opinions of pharmaceutists elicited in some other way, a Pharmacopœia might have been produced which would have commanded the confidence of all interested in its pages.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 4, 1864.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., Vice-President, in the Chair.*

Professor G. G. Stokes, M.A., D.C.L., Sec. R.S., read a paper "*On the Discrimination of Organic Bodies by their Optical Properties.*"

The chemist who deals with the chemistry of inorganic substances has ordinarily under his hands bodies endowed with very definite reactions, and possessing great stability, so as to permit of the employment of energetic reagents. Accordingly he may afford to dispense with the aids supplied by the optical properties of bodies, though even to him they might be of material assistance. The properties alluded to are such as can be applied to the scrutiny of organic substances; and therefore the examination of the bright lines in flames and incandescent vapours is not considered. This application of optical observation, though not new in principle (for it was clearly enunciated by Mr. Fox Talbot more than thirty years ago), was hardly followed out in relation to chemistry, and remained almost unknown to chemists until the publication of the researches of Professors Bunsen and Kirchhoff, in consequence of which it has now become universal.

But while the chemist who attends to inorganic compounds may confine himself without much loss to the generally-recognised modes of research, it is to his cost that the organic chemist, especially one who occupies himself with proximate analysis, neglects the immense assistance which in many cases would be afforded him by optical examination of the substances under his hands. It is true that the method is of limited application, for a great number of substances possess no marked optical characters; but when such substances do present themselves, their optical characters afford facilities for their chemical study of which chemists generally have at present little conception.

Two distinct objects may be had in view in seeking for such information as optics can supply relative to the characters of a chemical substance. Among the vast number of substances which chemists have now succeeded in isolating or preparing, and which, in many cases, have been but little studied, it often becomes a question whether two substances, obtained in different ways, are or are not identical. In such cases an optical comparison of the bodies will either add to the evidence of their identity, the force of the additional evidence being greater or less according as their optical characters are more or less marked, or will establish a difference between substances which might otherwise erroneously have been supposed to be identical.

The second object is that of enabling us to follow a particular substance through mixtures containing it, and thereby to determine its principal reactions before it has been isolated, or even when there is small hope of being able to isolate it; and to demonstrate the existence of a common proximate element in mixtures obtained from two different sources. Under this head should be classed the detection of mixtures in what were supposed to be solutions of single substances.*

Setting aside the labour of quantitative determinations carried out by well-recognised methods, the second object is that the attainment of which is by far the more difficult. It involves the methods of examination required for the first object, and more besides; and it is that which is chiefly kept in view in the present discourse.

The optical properties of bodies, properly speaking, include every relation of the bodies to light; but it is by no means every such relation that is available for the object in view. Refractive power, for instance, though constituting, like specific gravity, &c., one of the characters of any particular pure substance, is useless for the purpose of following a substance in a mixture containing it. The same may be said of dispersive power. The properties which are of most use for our object are—first, absorption; and, secondly, fluorescence.

Colour has long been employed as a distinctive character of bodies; as, for example, we say that the salts of oxide of copper are mostly blue. The colour, however, of a body gives but very imperfect information respecting that property on which the colour depends; for the same tint may be made up in an infinite number of ways from the constituents of white light. In order to observe what it is that the body does to each constituent, we must examine it in a pure spectrum. [The formation of a pure spectrum was then explained, and such a spectrum was formed on a screen by the aid of the electric light. On holding a cell containing a salt of copper in front of the screen, and moving it from the red to the violet, it was shown to cast a shadow in the red as if the fluid had been ink, while in the blue rays it might have been supposed to have been water. Chromate of potash similarly treated gave the reverse effect, being transparent in the red and opaque in the blue. Of course, the transition from transparency to opacity was not abrupt; and for intermediate colours the fluids caused a partial darkening. Indeed, to speak with mathematical rigour, the darkening is not absolute even when it appears the greatest; but the light let through is so feeble that it eludes our senses. In this way the behaviour of the substance may be examined with reference to the various kinds of light one after another; but in order to see at one glance its behaviour with respect to all kinds, it is merely requisite to hold the body so as to intercept the whole beam which forms the spectrum, to place it, for instance, immediately in front of the slit.]

To judge from the two examples just given, it might be supposed that the observation of the colour would give almost as much information as analysis by the prism. To show how far this is from being the case, two fluids very similar in colour, port wine and a solution of blood, were next examined. The former merely caused a general absorption of the more refrangible rays; the latter exhibited two well-marked dark bands in the yellow and green. These bands, first noticed by Hoppe, are eminently characteristic of blood, and afford a good example of the facilities which optical examination affords for following a substance which possesses distinctive characters of this nature. On adding to a solution of blood a particular salt of copper (any ordinary copper salt, with the addition of a tartrate to prevent precipitation, and then carbonate of soda), a fluid was obtained utterly unlike blood in colour, but showing the characteristic bands of blood, while at the same time a good deal of the red was absorbed, as it would have been by the copper salt alone. On adding, on the other hand, acetic acid to a solution of blood, the colour was merely changed to a browner red, without any precipitate being produced. Nevertheless, in the spectrum of this fluid the bands of blood had wholly vanished, while another set of bands less intense, but still very characteristic, made their appearance. This alone, however, does not decide whether the colouring matter is decomposed or not by the acid; for as blood is an alkaline fluid, the change might be supposed to be merely analogous to the reddening of litmus. To decide the question we must examine the spectrum when the fluid is again rendered alkaline, suppose by ammonia, which does not affect the absorption bands of blood. The direct addition of ammonia to the acid mixture causes a dense precipitate, which contains the colouring matter, which may, however, be separated by the use merely of acetic acid and ether, of which the former was already used, and the latter does not affect the colouring matter of blood. This solution gives the same characteristic spectrum as blood to which acetic acid has been added; but now there is no difficulty in obtaining the colouring matter in an ammoniacal solution. In the spectrum of this solution, the sharp absorption bands of blood do not appear, but instead thereof there is a single band a little nearer to the red, and comparatively vague [this was shown on a screen]. This difference of spectra decides the question, and proves that hæmatin (the colouring matter prepared by acid, &c.) is, as Hoppe stated, a product of decomposition.

The spectrum of blood may be turned to account still further in relation to the chemical nature of that substance. The colouring matter contains, as is well known, a large quantity of iron; and it might be supposed that the colour was due to some salt of iron, more especially as some salts of peroxide of iron, sulphocyanide for instance, have a blood-red colour. But there is found a strong general resemblance between salts of the same metallic oxide as regards the character of their absorption. Thus the salts of sesquioxide of uranium show a remarkable system of bands of absorption in the more refrangible part of the spectrum. The number and position of the bands differ a little from one salt to another; but there is the strongest family likeness between the different salts. Salts of sesquioxide of iron in a similar manner have a family likeness in the vagueness of the absorption, which creeps on from one part of the spectrum to another without presenting any rapid transitions from comparative transparency to opacity and the converse. [The spectrum of sulphocyanide of peroxide of iron was shown for the sake of contrasting with blood.] Hence the appearance of such a pecular system of bands of absorption in blood would negative the supposition that its colour is due to a salt of iron as such, even had we no other means of deciding. The assemblage of the facts with which we are acquainted seems to show that the colouring matter is some complex compound of the five elements, oxygen, hydrogen, carbon, nitrogen, and iron, which under the action of acids and otherwise, splits into hæmatin and globulin.

This example was dwelt on, not for its own sake, but because general methods are most readily apprehended in their application to particular examples. To show one example of the discrimination which may be effected by the prism, the spectra were exhibited of the two kinds of red glass which (not to mention certain inferior kinds) are in common use, and which are coloured, one by gold, and the other by suboxide of copper. Both kinds exhibit a single band of absorption near the yellow or green; but the band of the gold glass is situated very sensibly nearer

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* The detection of mixtures by the microscopic examination of intermingled crystals properly belongs to the first head, the question which the observer proposes to himself being, in fact, whether the pure substances forming the individual crystals are or are not identical.

to the blue end of the spectrum than that of the copper glass.

In the experiments actually shown, a battery of fifty cells and complex apparatus were employed, involving much trouble and expense. But this was only required for projecting the spectra on a screen, so as to be visible to a whole audience. To see them, nothing more is required than to place the fluid to be examined (contained, suppose) in a test tube, behind a slit, and to view it through a small prism applied to the naked eye, different strengths of solution being tried in succession. In this way the bands may be seen by any one in far greater perfection than when, for the purpose of a lecture, they are thrown on a screen.

(To be continued.)

ACADEMY OF SCIENCES.

April 18.

A note entitled "*Theoretical Researches on the Formation of Positive Photographic Prints,*" by MM. Davanne and Girard, was presented. The authors do not seem to have discovered anything new in the course of their researches, unless the following method of restoring faded prints be considered a novelty:—"If, in consequence of defective preparations, a print fades (yellow), the change may be arrested, and a part of its primitive brilliancy restored by toning it afresh in *a concentrated solution of neutral chloride of gold.* A note "*On the Action of Chlorine on Methyl,*" by Mr. Schorlemmer, was read. The author exposed to diffused light bottles full of a mixture of equal volumes of chlorine and methyl, and so obtained chlorhydric ether of vinic alcohol and a monochlorinated compound of the same ether. M. F. Pisani presented *An Analysis and Chemical Study of the Mineral Pollux* found in the island of Elba. This rare mineral had only been analysed by Plattner, who found it to be principally composed of silica, alumina, potash, and soda, but could only make the percentage sum of the constituents 92·75. M. Pisani has recently analysed a specimen of pollux, and found it to contain 34 *per cent. of cæsium.* The author points out that Plattner took the precipitated chloro-platinate as a potassium compound, and calculated accordingly; but if the chloroplatinate be calculated for cæsium, the numbers are found to closely agree with those obtained by M. Pisani himself. This shows the importance of setting down the results of analyses conscientiously without making up the "loss."

M. Remalé communicated a note "*On the Sulphur Compounds of Uranium.*" The author poured an excess of sulphide of ammonium into a solution of nitrate of uranium in alcohol, and obtained a brown precipitate which he believes to be a *sulphide of uranyle* $(Ur_2O_2)S$. M. Peligot supposes the existence of the radical uranyle to account for the circumstance that sesquioxide of uranium forms neutral salts with one equivalent of acid. Thus, the sesquioxide is the oxide of uranyle $(Ur_2O_2)O$.

MM. Berthelot and Fleurica contributed a note "*On the Proportion of Tartaric Acid in Grape Juice and Wine.*" The researches of the authors show that the vinous fermentation is a very complicated process—much more complicated than the alcoholic fermentation properly so-called. It seems that in the course of fermentation much of the acidity of the grape juice disappears beyond that which can be accounted for by the precipitation of cream of tartar—"a circumstance the more unexpected," say the authors, "since the fermentation itself produces acids."

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"On the Organic Peroxides Theoretically Considered," by Sir B. C. Brodie.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(EIGHTEENTH NOTICE.)

(Continued from page 154.)

We come now to the section of Report devoted to the industry of distilled hydrocarbons. The reporter here gracefully acknowledges the assistance of Dr. Frankland, who seems to have furnished a chronological sketch of the industry, interwoven with descriptions of products and processes.

It was just before the Exhibition of 1851 that Mr. Young began to distil boghead coal at a low red heat, and so commenced in this country the manufacture which has received such an extraordinary development. In 1857 Mr. De La Rue took out a patent for distilling Rangoon tar, first with a current of steam to remove the lighter oils, and then with superheated steam to obtain paraffin. At the date of the French Exhibition (in 1855) the condition of the industry is thus summed up:—1. Boghead coal was being largely distilled for the liquid and solid products, used, for the most part, as lubricating, but also to some extent as illuminating agents. 2. The same products were also obtained from gas tar. 3. Bituminous schist, resin, and peat were being largely worked for similar purposes, chiefly for illuminating agents. 4. Lastly, Mr. De La Rue had called attention to the value of native tar as a source of similar products.

This, it must be confessed, is but a very meagre sketch of the early (some will say late) history of the industry of distilled hydrocarbons; but it is all this report affords us, and we pass on to the processes of distillation and purification now in use. Mr. Young, as everybody now knows, distils boghead coal at a low red heat; the crude oil so obtained is treated with a current of steam to remove the naptha; the residue is then treated with strong sulphuric acid, whereby naphthaline and a number of products of a similar composition to olefiant gas are decomposed. Agitation with a strong solution of caustic soda now causes the separation of tarry matter, which takes its place between the soda lye and the purified oil, when the mixture is left at rest. The oil is now run off, and rectified by distillation; the more volatile part is sold as an illuminating, and the less volatile as a lubricating agent.

Gas-tar is treated differently. It is first rectified, and the distillate is then mixed with a solution of chloride of lime. The mixture is then briskly agitated, and diluted hydrochloric acid is added until all the chlorine is expelled from the chloride. The more alterable portion of the oil is thus oxidised, and subsequent treatment with soda lye, as in the former instance, separates the tar, and leaves the supernatant oil free for rectification. The richer tar from Scotch cannels it seems can be profitably treated in this way.

Petroleum or rock oil, from the United States and Canada, are, however, at present formidable competitors with the distilled oils; but how little the manufacture of the oils has been affected may be judged from the statement made in this report, that the production of paraffin oil in the United Kingdom "during the last year [1862, we presume] reached the enormous amount of 2,300,000 gallons."

The manufacture of paraffin and the accessory products from a light coloured lignite, is carried on to a considerable extent in Prussia, and a very good description of the processes employed is given in the Report. The lignite appears to be first distilled for tar, which is first freed from water, and then rectified: the distillate now obtained is treated with caustic soda to remove carbolic acid. After the separation of the carbolate of soda solution, the oils are treated with sulphuric acid, and the purification carried on in the ordinary way. The acid solution separated in this latter part of the process is mixed with the alkaline carbolate and the crude carbolic acid obtained is used to impregnate railway sleepers, while the sulphate of soda is sold to alkali makers. The method used for purifying the paraffin we need not notice. One ton of this light coloured lignite it seems will yield 31·5 lbs. of hard paraffin, 31·5 lbs. of soft paraffin, 70 lbs. of photogen (lighter oil) and 80 lbs. of solar (heavier) oil. The softer paraffin is mixed with stearine and made into candles.

We may quote here the results obtained by Wagenmann, who made numerous determinations of the amounts of products obtainable by the distillation of peat, lignite, and bituminous shale.

	Photogen, sp. gr. 0·815-0·835	Solar Oil, sp. gr. 0·870-0·890	Crude Solid Paraffin.
Hard, dark-brown peat, containing 33·58 per cent. of water, and 6·76 per cent. of ash	0·435	1·10	1·943
Brown fibrous peat, containing 36·23 per cent. of water, and 5·49 per cent. of ash	0·380	1·124	2·389
Hard, dark-brown lignite, occurring in small fragments, and containing 45·26 per cent. of water, and 9·83 per cent. of ash	0·810	3·940	3·910
Bituminous shale, containing 19·9 per cent. of water, and 23·52 per cent. of ash	8·160	1·590	12·870

The results seem to show that the extraction of these illuminating and lubricating agents from peat is not likely to be profitable as long as they have to compete with the products from coal and lignite.

Photogen, according to Herr Wagenmann, "should be very mobile, as it has frequently to ascend a wick to the height of six inches. The best has the sp. gr. 0·815 to 9·835. Those which have the sp. gr. of only 0·78 are dangerous, as they contain oils which boil at 60° C., and readily forming explosive mixtures in the air-spaces of the lamps in which they are consumed. On the other hand, photogen sp. gr. 0·840 and upwards is nearly useless, as it cannot ascend a wick with sufficient facility.

"Solar oil should not contain any oils of less sp. gr. than 0·870, nor more than 0·920. Its sp. gr. generally ranges between 0·885 and 0·895. Cooled to 10° C., it ought not to deposit paraffin; and when agitated the bubbles of air ought not to rise to the surface more rapidly than in colza oil.

"Lubricating oil ought to have a sp. gr. varying from 0·920 to 0·950, and to possess but a very slight odour. It is frequently mixed with Gallipoli oil. Although it contains paraffin, it ought not to deposit any when cooled to 2° C."

The report gives no account of the practical mode and the results of coal distillation in this country, which it is remarked "is a source of considerable disappointment."

We can notice but briefly the Russian works, near Bakou, on the Caspian. Here the inflammable gas which issues from the earth is collected in gasholders, and used as a source of heat for the distillation of the petroleum, and also a bitumen, called *naphthagil*. There is another factory on the island Svatoi, on the Caspian, where a substance resembling dark coloured wax and named *naphthadehyl* is distilled. The substance is found in large quantities on the island, and also on the eastern shores of the Caspian. The successful working of these deposits suggests the possibility of the similar utilisation of the analogous deposit found in Derbyshire. In the hope of this, it seems that this substance, locally known as "Devil's dung," is being stored in caves on the High Peak.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

3307. John Dale and Heinrich Caro, Manchester, "Improvements in obtaining colouring matters for dyeing and printing."—Petition recorded December 31, 1863.

543. Alfred Ford, Trafalgar Works, Peckham, Surrey, "An improved method of manufacturing floor cloth."—Petition recorded March 4, 1864.

605. John Clayton, Wolverhampton, Staffordshire, "Improvements in reverberatory and other furnaces for heating and melting iron and steel, and for other like purposes."

627. Robert Hanham Collyer, M.D., Ph.D., F.C.S., Beta House, Alpha Road, St. John's Wood, London, "An improved apparatus and process for the conversion of substances into material for the manufacture of paper and textile purposes."

632. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the manufacture of soap."—A communication from Jean Baptiste Vasseur and Alexis Mahot, Paris.

635. Raymond Fletcher, Siddall's Road, Derby, "A new compound used for varnishing paperhangings and other articles."

674. Richard Archibald Brooman, Fleet Street, London, "Improvements in treating vegetable textile matters in separating filamentous matters therefrom, and the application of such matters to spinning, weaving, and dyeing."—A communication from Etienne Mallard, Florentin Bonneau, Adolphe Dumont, and Napoleon Jean Claude Canoby, Paris.

677. John Dauglish, M.D., Reading, Berkshire, "Improvements in the manufacture of aërated bread, and in apparatus to be used in this manufacture."

695. Frederick Tolhausen, Boulevart Magenta, Paris, "An improved process for preserving iron from corrosion, as produced by the influence of air and sea water."—A communication from Mr. Charles de Bussy, Avenue de Villars, Paris.—Petition recorded March 18, 1864.

Notices to Proceed.

584. James Preston Worrall, Ordsall, Lancashire, "Certain improvements in dyeing or colouring looped, cut pile, or raised textile fabrics composed of cotton and silk."—Petition recorded March 9, 1864.

2951. Davis Wilson Rea, Upper Thames Street, London, "Improvements in preserving animal and vegetable substances."—Petitions recorded November 29, 1863.

2963. George Parkin, Tryddyn, Flintshire, "Improvements in apparatus employed in the manufacture of paraffin and other like oils from shale, cannel, and other minerals."

2980. Thomas Gray, Mitcham, Surrey, "A new method of discharging colour from rags used for papermaking or other purposes, and in treating of vegetable fibres by such process."

2987. Heinrich Hirzel, Terminus Hotel, London Bridge, Southwark, Surrey, "Improvements in extracting essences and perfumes, and also oils and fats from matters containing them; also in bleaching and purifying oils and fats, and in apparatus employed therein."—Petitions recorded November 27, 1863.

3022. William Wilson, Manchester, "Improvements in generating gas for illuminating and other purposes, when made by passing atmospheric air over or through volatile oils, and treating such gas and the gas made from coal or cannel, after leaving the generators, so as to improve the heating and illuminating qualities thereof, and in the apparatus for effecting the same."

3029. Henry Holdrege, Irvington, New York, U.S., "Improvements in the process and manner of making gas for illuminating, heating, and other purposes, a part of which may also be applied to the production of metallic oxides."—A communication from William Henry Gwynne, New York, U.S.

CORRESPONDENCE.

Identity of Aconella with Narcotine.

To the Editor of the Chemical News.

Sir,—Having received, some time ago, from my friend, Mr. H. Draper, a specimen of the alkaloid discovered by Messrs. T. and H. Smith, of Edinburgh, in aconitum napellus, I thought it probable that some interesting results might be obtained by submitting a solution of the alkaloid to the action of polarised light. My object was to compare the change in the plane of polarisation of a ray, produced by transmission through a tube filled with this solution, with the change similarly produced by a solution of narcotine. This I was enabled to do with very great accuracy by means of an instrument which I described at a meeting of the Royal Irish Academy in January, 1863.

The experiment was made as follows:—

1. I dissolved 2·95 gr. of aconella in 1½ cubic inches of chloroform, and determined the rotatory power of the solution. I then made a solution of narcotine of the same strength, and measured its rotatory power in the same way, Had these powers differed from each other by the $\frac{1}{50}$th part, I could not have failed to see that they were unequal. No difference, however, could be detected.

2. Knowing the rotation produced by a solution of narcotine to be reversed by the addition of an acid, I was anxious to ascertain whether the same were true of a solution of aconella. In this experiment I was obliged to use as the solvent rectified spirit, inasmuch as the water contained in the dilute acid which I employed would have rendered the chloroform turbid. This made the experiment more difficult, narcotine being very sparingly soluble in spirit. In fact, I was with difficulty able to dissolve one grain of either substance in a cubic inch of cold spirit.

Having made two similar solutions of aconella and narcotine, I measured their rotatory powers before and after the addition of an acid. The results were as follows:—

a. In both cases the rotation was reversed.

b. Working by m, the ratio of the left-handed rotation produced by the solution of aconella to the right-handed rotation produced by the same solution when acidulated, and by m', the same ratio for narcotine, I found—

$$\frac{m}{m'} = 1·02.$$

The acid used was hydrochloric, and was added in excess; the same quantity, of course, being used for each solution.

These results seem to leave little doubt of the identity of aconella with narcotine. I am, &c.

John H. Jellett,
Professor of Natural Philosophy to the
University of Dublin.

Trinity College, Dublin, April 26.

MISCELLANEOUS.

Chemistry at the College of Physicians.—It is related in the pages of one of our contemporaries, that at a recent meeting of the College of Physicians, Dr. Frederic Farre made the following statement in reference to the change of names of the chlorides of mercury in the British Pharmacopœia:—"When the chemical equivalent of mercury was 100, calomel was the chloride and corrosive sublimate the bichloride; but at the time of the preparation of the new Pharmacopœia, most distinguished chemists held that the chemical equivalent of mercury was 200; thus calomel became the subchloride and corrosive sublimate the chloride, and it was necessary to define them accordingly. He (Dr. Farre) believed that quite recently some chemists had reverted to the old notion that the chemical equivalent of mercury was only 100." As the meetings of the College are not officially reported, we have no means of knowing whether Dr. Farre's words were correctly taken down or not; but the statement is a series of mistakes from beginning to end. The facts are that when the equivalent of mercury was 200, calomel was the chloride and corrosive sublimate the bichloride, but at the time of the preparation of the British Pharmacopœia some chemists held that the chemical equivalent of mercury was 100; but now (April, 1864), some other chemists are reverting to the old notion that the chemical equivalent of mercury is 200. Thus Dr. Farre's statements ought all to be reversed in order to be accurate. By the established rules of chemical nomenclature, 200Hg. + 72Cl. must be the bichloride, or corrosive sublimate; and 200Hg. + 36Cl. must be the chloride, while if the chemical equivalent of mercury be 100, then 100Hg. + 36Cl. must be the chloride (still corrosive sublimate), and 200Hg. + 36Cl. (doubling the equivalent of mercury), must be the subchloride. We offer these remarks to the College of Physicians, and to the Chemical Fellows who were probably present at the meeting, as Dr. Alfred Taylor, Dr. Bence Jones, Dr. Garrod, Dr. Owen Rees, and others.—*Medical Circular*.

Royal Institution. — Monday, May 2, at two, Anniversary Meeting. Tuesday, May 3, at three, Professor Marshall, "On Animal Life." Thursday, May 4, at three, John Hullah, Esq., "On Music" (1600-1750). Friday, May 5, at eight, Professor Roscoe "On Indium, &c." Saturday, May 6, at three, Professor Frankland "On the Metallic Elements."

Why Bees Work in the Dark. — A lifetime might be spent in investigating the mysteries hidden in a bee-hive, and still half of the secrets would be undiscovered. The formation of the cell has long been a celebrated problem for the mathematician, whilst the changes which the honey undergoes offer at least an equal interest to the chemist. Every one knows what honey fresh from the comb is like. It is a clear yellow syrup, without a trace of solid sugar in it. Upon straining, however, it gradually assumes a crystalline appearance—it *candies*, as the saying is—and ultimately becomes a solid mass of sugar. It has not been suspected that this change was a photographic action. That the same agent which alters the molecular arrangement of the iodide of silver on the excited collodion plate, and determines the formations of camphor and iodine crystals in a bottle, causes the syrupy honey to assume a crystalline form. This, however, is the case. M. Scheibler has enclosed honey in stoppered flasks, some of which he has kept in perfect darkness, whilst others have been exposed to the light. The invariable result has been that the sunned portion rapidly crystallises, whilst that kept in the dark has remained perfectly liquid. We now see why bees are so careful to work in perfect darkness, and why they are so careful to obscure the glass windows which are sometimes placed in their hives. The existence of their young depends on the liquidity of the saccharine food presented to them, and if light were allowed access to this the syrup would gradually acquire a more or less solid consistency; it would seal up the cells, and in all probability prove fatal to the inmates of the hives. — *Chronicle of Optics, "Quarterly Journal of Science."*

ANSWERS TO CORRESPONDENTS.

W. H. D.—Of Griffin, Bunhill-row, London.

Constant Reader.—Add any soluble sulphide to a salt of silver.

Book Received.—"The Prescriber's Pharmacopœia," by a Practising Physician.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Some Curious Properties of Oxide of Silver, by M. Boettger.

M. Boettger has remarked that oxide of silver yields its oxygen to combustible matters quite as readily as does peroxide of lead PbO_2, which, on account of this property is very largely employed in the manufacture of chemical matches.

A very dry mixture of about two parts of oxide of silver and one of sulphur ignites by friction in a mortar or even between folds of paper. It makes no difference if the antimony compound is replaced by black sulphide of antimony, realgar, or piment.

The same thus occurs with amorphous phosphorus as with tannin. Gallic acid does not induce combustion.

A drop of phenic acid or creosote poured on very dry oxide of silver causes an instantaneous flame.

Flour of sulphur also ignites when triturated with this oxide; selenium the same.—*Journ. für Prakt. Chemie*, xc., 32.

Preparation of Suboxide of Copper, by M. R. Boettger.

Suboxide of copper, says M. Boettger, is obtained in great perfection by the following process:—Dissolve in 2 parts of hot distilled water 1 part of crystallised sulphate of copper, 1½ part of tartrate of potash and soda and 2 parts of cane-sugar; when the solution is complete, and tartrate of copper formed, add 1½ part of caustic soda. By boiling the mixture, the suboxide of copper is gradually precipitated, losing its odour completely, as in saccharometric experiments.

The product is of a beautiful red colour, and after it is washed and dried will keep without alteration; before being dried the author advises its being washed in a little alcohol.—*Journ. für Prakt. Chemie*, xc., 163.

TECHNICAL CHEMISTRY.

*Preparation of Aniline Green.**

The first notice of the reaction which produces aniline green was made by M. Eusebe, who dissolved crystallised aniline red in a mixture of alcohol with sulphuric, hydrochloric, or some other acid, and added a certain proportion of aldehyde or wood spirit. The solution becomes at first violet, and passes gradually to a bright blue. (The changes, however, are not constant.) Hyposulphite of soda is now added, and the mixture is heated, when the mixture assumes a beautiful green colour. The above process has many inconveniences; but the colour may be easily and quickly produced in the following way:—

150 grammes of crystallised sulphate of rosaniline are dissolved in 450 grammes of cold diluted sulphuric acid (three parts of acid to one of water). When the solution is complete 225 grammes of aldehyde are added, the mixture being stirred. The whole is now heated in a water-bath. From time to time a drop of the mixture is taken up with a stirring-rod and dropped into slightly acidulated water, and as soon as a deep green solution is obtained the reaction is stopped. The mixture is now poured into 30 litres of boiling water, and to this solution is gradually added 450 grammes of hyposulphite of soda, dissolved in the smallest possible quantity of water. The whole is now boiled for some minutes. All the green remains in the solution, which may be used to dye silk. The green is very beautiful, especially in artificial light, which distinguishes it from all other shades of the same colour.

PHARMACY, TOXICOLOGY, &c.

The Alkaloids of Aconite.

Aconella.—This substance, the optical properties of which have been investigated by Professor Jellett, was described by the Messrs. Smith in the *Pharmaceutical Journal* for January of this year. The mode in which they obtained it was as follows:—Juice of aconite root is evaporated to an extract, and then exhausted with spirit of wine; the spirit having been distilled off, the remainder is brought to an extract, which is also exhausted with spirit. Milk of lime is now added to the spirituous solution, and the liquor filtered. After filtration, sulphuric acid is added till there is no further precipitate. The liquor is again filtered, and the spirit distilled off. The watery portion left, after the separation of the green fatty matter, is filtered.

The liquor is strongly acid, and is now *nearly* neutralised with carbonate of soda. None of the aconitine will be thrown down until the liquor is alkaline.

On being left to itself for a day or two, the still slightly acid liquor deposits an abundant precipitate, which settles partly as a loose powder and partly in a crystalline state on the sides of the vessel. This precipitate furnishes *Aconella*, which can be obtained in snow-white crystalline tufts by repeated crystallisations from boiling alcohol and treatment with animal charcoal.

Aconella is very insoluble in water, but moderately soluble in boiling spirit and in ether. It is entirely consumed when burnt on platinum foil, and yields ammonia when treated with soda-lime. Tannin precipitates the oxalate, but not the muriate. It is precipitated by tincture of iodine, by corrosive sublimate, by terchloride of gold, and by bichloride of platinum. A distinguishing characteristic of the alkaloid is its tendency to crystallise. It appears to possess no poisonous qualities.

Besides the identity of optical properties mentioned by Professor Jellett last week, aconella presents so many other resemblances as to lead to the supposition that the two bodies are absolutely identical. Aconella, like narcotine, is tasteless in the solid state, but the solutions of both are very bitter. Both bodies are precipitated by tincture of iodine. Tannin precipitates the oxalate of both, but not the muriate. They have the same solubility in spirit, and the crystallisations of the two bodies are the exact counterparts of each other. Lastly, the equivalent of aconella, calculated from the platinum salt, appears to be 426·68, while that of narcotine is 427. The closeness of these numbers and the identity of the optical properties seem to leave no doubt that the same alkaloid is to be found in opium and the root of the Aconitum napellus.

Preparation of Aconitine.—The process for the preparation of aconitine, extracted from a thesis by M. Hottot, and given at page 200, vol. viii. of the Chemical News, has been somewhat modified by the author, who has adopted the following method of extracting the alkaloid:—Aconite root is digested in rectified spirit for eight days, and then percolated. The spirit is then distilled off over a water-bath, and the residue is treated

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* *Moniteur Scientifique*, April 15, 1864, p. 362.

with slaked lime, shaken occasionally, and filtered. The liquor is now precipitated with a slight excess of sulphuric acid, and evaporated to the consistence of a syrup. Two or three times its weight of water is added to the residue, which is then allowed to rest for some time, that the green oil may separate. This oil solidifies at 20° C., and may be removed from the surface, the last traces being separated by filtration through a wet filter. Ammonia is added to the filtrate, and the mixture heated to boiling; aconitine is thus precipitated in a compact mass which is easily separated from the liquor, but which contains a good deal of resin. The precipitated mass is washed, and then treated with *pure* ether, which dissolves the aconitine and leaves the greater part of the resin behind. The etherial solution is allowed to evaporate spontaneously, and the aconitine is further purified by repeated solution in sulphuric acid and careful precipitation with ammonia. At last the precipitate is washed and dried at a low temperature.

Napellina.— Aconite root appears to contain two distinct substances, which possess in different degrees the physiological properties of aconitine. One is the amorphous and pulverulent aconitina, which M. Hottot could not obtain in crystals; the other is a body which can be procured in well-defined crystals, and which acts in the same way as aconitina, but with much less energy. For this body Mr. Morson, who first obtained it, has proposed the name *Napellina.*

The chemistry of napellina, so far as we know, has yet to be studied.

The reactions of aconitina are as follows:—The solid heated with strong sulphuric acid is first coloured yellow, then violet red; with a solution tannin gives an abundant precipitate; ioduretted iodide of potassium occasions a kermes-coloured precipitate. The latter solution is said to be the best antidote in cases of poisoning. Iodide of mercury and potassium gives a clotty, yellowish-white, and chloride of gold a yellow precipitate. Chloride of platinum gives no precipitate.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Thursday, April 21, 1864.

Major-General Sabine, *President, in the Chair.*

A paper, by Professor F. A. Abel, F.R.S., "*On some Phenomena exhibited by Gun-cotton and Gunpowder under Special Conditions of Exposure to Heat.*"

(*Continued from page 209.*)

In describing the phenomena which accompany the ignition of gun-cotton in atmospheres of different rarefaction, it was pointed out that, at pressures varying from one to twenty-four in inches of mercury, a pale yellow flame was observed, which increased in size with the pressure of the atmosphere; and that a flame of precisely the same character was produced in rarefied atmospheres of nitrogen. The same result was observed in atmospheres of carbonic acid, carbonic oxide, hydrogen, and coal-gas. In operating with pieces of gun-cotton-twist or thread of some length, instead of employing the material in loose tufts, the results obtained in the two last-named gases were very different from those observed in atmospheres of nitrogen, carbonic acid, and carbonic oxide. When ignited by means of a platinum wire (across which it was placed), in vessels filled with either of those two gases, and completely closed or open at one end, the piece of twist burned slowly and regularly, the combustion proceeding much more deliberately than if the same piece of gun-cotton had been ignited in the usual manner in air, and being accompanied by only a very small jet or tongue of pale yellow flame, which was thrown out in a line with the burning surface, when the gun-cotton was ignited. The same result was obtained in currents of those gases when passed through a long wide glass tube, along which the gun-cotton twist was laid, the one end being allowed to project some distance into the air. The projecting extremity being ignited, the character of the combustion of the gun-cotton was changed from the ordinary to the slow form as soon as the piece of twist had burned up to the opening of the tube through which the gas was passing. On repeating this form of experiment in currents of hydrogen and of coal-gas, the ignited gun-cotton burned in the slow manner only a very short distance inside the tube, the combustion ceasing altogether when not more than from half an inch to one inch of the twist had burned in the tube. The same result was observed when the current of gas was interrupted at the moment that the gun-cotton was inflamed. It was at first thought that this extinction of the combustion of gun-cotton by hydrogen and coal-gas might be caused by the very rapid abstraction of heat from the burning surface of gun-cotton, in consequence of the diffusive powers of those gases; but when the experiments were made in perfectly closed vessels, the piece of gun-cotton-twist being ignited by means of a platinum wire, the combustion also ceased almost instantaneously. These effects can, therefore, only be ascribed to the high cooling powers by connection of the gases in question.

The slow kind of combustion of gun-cotton, in the form of twist, which is determined by its ignition in currents or atmospheres of nitrogen, carbonic acid, &c., may also be obtained in a powerful current of atmospheric air, the thread of cotton being placed in a somewhat narrow glass tube. If, however, the air is at rest, or only passing slowly, the result is uncertain. In employing very narrow tubes, into which the gun-cotton fits pretty closely, the combustion passes over into the slow form when it reaches the opening of the tube, and occasionally it will continue to do so throughout the length of the tube. Sometimes, and especially when wider tubes are employed, the slow combustion will proceed only for a short distance, and then, in consequence of the ignition of a mixture of the combustible gases and air within the tube, the gun-cotton will explode with great violence, the tube being completely pulverised, and portions of unburnt cotton scattered by the explosion. If still wider tubes are employed, the cotton will flash into flame almost instantaneously throughout the tube directly the flame reaches the opening. In these cases the explosion is not violent; the tube escapes fracture sometimes, and at others is broken in a few places or torn open longitudinally, a slit being produced in the tube directly over the gun-cotton. By the employment of a screen of card-board, containing a perforation of the same diameter as that of the gun-cotton-twist, through which the latter was partially drawn, the alteration of the combustion of the material from the ordinary to the slow kind was found to be invariably effected.

These results indicate that if, even for the briefest space of time, the gases resulting from the first action of heat on gun-cotton, upon its ignition in open air, are impeded from completely enveloping the burning extremity of the gun-cotton-twist, their ignition is prevented; and as it is the comparatively high temperature produced by their combustion which effects the rapid and more complete combustion of the gun-cotton, the momentary extinction of the gases, and the continuous extraction of heat by them as they escape from the point of combustion, render it impossible for the gun-cotton to continue to burn otherwise than in the slow and imperfect manner, undergoing a transformation similar in character to destructive distillation.

These facts appear to be fully established by the following additional experimental results:—

With a loose twist of cotton it was found impossible to effect the described change in the nature of the combustion, because the gases do not simply burn at, or escape from, the extremity of the twisted cotton, but pass readily between the separated fibres of the material; and hence transmit the combustion at once, from particle to particle, and maintain the heat necessary for their own combustion.

If a piece of the compactly twisted gun-cotton, laid upon the table, be inflamed in the ordinary manner, and a jet of air be thrown against the flame, in a line with the piece of cotton, but in a direction opposite to that in which the flame is travelling, the combustion may readily be changed to the slow form, because the flame is prevented from enveloping the burning cotton, and thus becomes extinguished, as in the above experiment.

Conversely, if a gentle current of air be so directed against the gun-cotton, when undergoing the slow combustion, that it throws back upon the burning cotton the gases which are escaping, it will very speedily burst into the ordinary kind of combustion. Or, if a piece of the gun-cotton-twist, placed along a board, be made to burn in the imperfect manner, and the end of the board be then gradually raised, as soon as the material is brought into a nearly vertical position, the burning extremity being the lowest, it will burst into flame.

By applying to the extremity of a piece of the compact twist a heated body, the temperature of which may range from 135° C. even up to a red heat, provided the source of heat be not very large in proportion to the surface presented by the extremity of the gun-cotton, the latter may be ignited with certainty in such a manner that the slow form of combustion at once ensues, the heat applied being insufficient to inflame the gases produced by the decomposition of the gun-cotton. By allowing the gun-cotton thus ignited to burn in a moderately wide tube, closed at one end, the inflammable gases produced may be burned at the mouth of the tube while the gun-cotton is burning in the interior; or they may be ignited, and the gun-cotton consequently inflamed, by approaching a flame, or body heated to full redness, to the latter, in the direction in which they are escaping. It need hardly be stated that these results are regulated by the degree of compactness of the gun-cotton, the size of the twist, and the dimensions of the heated body.

The remarkable facility with which the nature of combustion of gun-cotton in air or other gases may be modified constitutes a most characteristic peculiarity of this substance as an explosive; which is not shared by gunpowder or explosive bodies of that class, and which renders it easily conceivable that this material is susceptible of application to the production of a comparatively great variety of mechanical effects, the nature of which is determined by slight modifications in its physical condition, or by what might at first sight appear very trifling variations of the conditions attending its employment.

There is little doubt that the products of decomposition of gun-cotton vary almost as greatly as the phenomena which attend its exposure to heat under the circumstances described in this paper. A few incidental observations, indicative of this variation, were made in the course of the experiments. Thus, in the instances of the most imperfect metamorphosis of gun-cotton, the products included a considerable proportion of a white vapour, slowly dissolved by water, as also small quantities of nitrous acid and a very large proportion of nitric oxide. The latter gas is invariably formed on the combustion of gun-cotton in air or other gases; but the quantity produced appears always to be much greater in instances of the imperfect or slow combustion of the material. The odour of the gases produced in combustions of that class is powerfully cyanic, and there is no difficulty in detecting cyanogen among the products. The author has already satisfied himself, by some qualitative experiments, of the very great difference existing between the results of the combustion of gun-cotton in open air, in partially confined spaces, and under conditions precisely similar to those which attend its employment for projectile or destructive purposes. He has, for example, confirmed the correctness of the statement made by Karolyi in his analytical account of the products of decomposition of gun-cotton, that no nitric oxide or higher oxide of nitrogen is eliminated upon the explosion of gun-cotton under considerable pressure, as in shells. Coupling this fact with the invariable production of nitric oxide, when gun-cotton is exploded in open air or partially confined spaces, there appears to be very strong reason for the belief that, just as the reduction of pressure determines a proportionately imperfect and complicated transformation of the gun-cotton upon its exposure to heat, the results of which are more or less essentially of an intermediate character, so, conversely, the greater the pressure, beyond the normal limits, under which gun-cotton is exploded, that is to say, the greater the pressure exerted by it, or the resistance presented at the first instant of its ignition, the more simple are the products of decomposition, and the greater are the physical effects attending its explosion, because of the greater energy with which the chemical change is effected.

A paper "*On Magnesium*," by Dr. T. L. Phipson, F.C.S.S., was then read. Iodine can be distilled off magnesium without attacking the metal in the least. In the same manner sulphur distils off magnesium without the metal being at all attacked. Heated for some time in a porcelain crucible with excess of anhydrous silica, magnesium burns vividly if the air has access, and a certain quantity of amorphous silicium is immediately formed. The metal is, therefore, capable of reducing silicic acid at a high temperature. The reason why potassium and sodium cannot effect this is simply because these metals are highly volatile, and fly off before the crucible has attained the proper temperature. Magnesium being much less volatile than the alkaline metals, takes oxygen from silica before volatilising. If the silicic acid be in excess, a silicate of magnesia is formed at the same time; if the metal is in excess, much siliciuret of magnesium is produced. The presence of the latter is immediately detected by throwing a little of the product into water acidulated with sulphuric acid, when the characteristic phosphoric odour of siliciuretted hydrogen is at once perceived. With boracic acid the phenomena are rather different: the acid melts and covers the metal, so that it does not inflame even when the crucible is left uncovered. A certain quantity of boron is soon liberated, and the product forms a greenish-black mass, which oxidises and becomes white in contact with water, and disengages no odoriferous gas in acidulated water. Dry carbonate of soda was heated with a little magnesium in a glass tube over a common spirit-lamp, and before the temperature had arrived at a red heat it was observed that carbon was liberated abundantly, and magnesia formed. A solution of caustic alkali or ammonia has little or no action upon magnesium in the cold. *Precipitation of Metallic Solutions.*—Magnesium precipitates nearly all the metals from their neutral solutions; when these are taken in the form of protosalts, even manganese, iron, and zinc are precipitated as black powders. Aluminium and uranium (and perhaps chrome) are only precipitated as oxides. *Alloys of Magnesium.*—I have examined only a few alloys of magnesium. Unlike zinc, magnesium will not unite with mercury at the ordinary temperature of the air. With tin eighty-five parts, and magnesium fifteen parts, I formed a very curious alloy of a beautiful lavender colour, very hard and brittle, easily pulverised, and decomposing water with considerable rapidity at ordinary temperatures. If the air has access during the formation of this alloy, the mixture takes fire; and if the crucible be then suddenly withdrawn from the lamp, the flame disappears, but a vivid phosphorescence ensues, and the unfused mass remains highly luminous for a considerable time. A white powdery mass, containing stannic acid and magnesia, is the result. [With platinum, according to Mr. Sonstadt, magnesium forms a fusible alloy; so that platinum crucibles can be easily perforated by heating magnesium in them.] Sodium and potassium unite with magnesium, and form very malleable alloys, which decompose water at the ordinary temperature. It is probable that an alloy of copper and magnesium, which I have not yet obtained, would differ from brass, not only in lightness, but by decomposing water at the ordinary temperature with more or less rapidity. *Uses.*—Magnesium will be found a useful metal wherever tenacity and lightness are required, and tarnish is of no consequence. The light furnished by combustion of the wire has already been utilised in photography at night. In the laboratory it will be found useful to effect decompositions which sodium and potassium cannot effect, on account of their greater volatility.

Thursday, April 28.

Major-General Sabine, *President, in the Chair.*

The following papers were read:—"*On the Magnetic Elements and their Secular Variations at Berlin*," by Mr. A. Erman; "*On the Calculus of Symbols*," by Mr. W. H. L. Russell; "*On the Action of Chlorine upon Methyl*," by Mr. C. Schorlemmer. The last author exposed mixtures of chlorine and methyl to the action of diffused light, and observed the formation of drops of an oily liquid, the greater part of which evaporated at the temperature of 15°. By absorbing the hydrochloric acid produced with a little weak solution of soda, and then displacing the vapours by means of a warm solution of salt, condensing them as they escaped in a tube surrounded with freezing mixture, the author obtained a liquid which, on careful re-distillation yielded a product boiling between 11° and 12°, and which proved to be the chlorhydric ether of vinic alcohol. The residue boiled between 65° and 70°, and was the mono-chlorinated hydrochloric ether of vinic alcohol. Eight litres of methyl gave but eight grammes of the mixed chlorides, only a third part of what, according to theory, should have been found. The experiments prove that the first term of the series of alcoholic radicals is attacked by chlorine just in the same manner as its homologues ethyl-amyl, which gives chloride of heptyl, and amyl, which gives chloride of decatyl. The other terms of the series will no doubt submit to similar reactions. The author believes that by commencing with marsh gas, we may obtain not only all the terms of the series, but also produce synthetically the various mono- dia- and poly-atomic compounds, of which these hydrocarbons form the radicals.]

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 4, 1864.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., Vice-President, in the Chair.*

Professor G. G. Stokes, M.A., D.C.L., Sec. R.S., read a paper "*On the Discrimination of Organic Bodies by their Optical Properties.*"

(*Continued from page 214.*)

In order to be able to examine the peculiarities which a substance may possess in the mode in which it absorbs light, it is not essential that the substance should be in solution, and viewed by transmission. Thus, for example, when a pure spectrum is thrown on a sheet of paper painted with blood, the same bands are seen in the yellow and green region as when the light is transmitted through a solution of blood, and the spectrum thrown on a white screen. This indicates that the colour of such a paper is in fact due to absorption, although the paper is viewed by reflected light. Indeed, by far the greater number of coloured objects which are presented to us, such as green leaves, flowers, dyed cloths, though ordinarily seen by reflection, owe their colour to absorption. The light by which they are seen is, it is true, reflected, but it is not in reflection that the preferential selection of certain kinds of rays is made which causes the objects to appear coloured. Take, for example, red cloth. A small portion of the incident light is reflected at the outer surfaces of the fibres, and this portion, if it could be observed alone, would be found to be colourless. The greater part of the light penetrates into the fibres, when it immediately begins to suffer absorption on the part of the colouring matter. On arriving at the second surface of the fibre, a portion is reflected and a portion passes on, to be afterwards reflected from, or absorbed by, fibres lying more deeply. At each reflection the various kinds of light are reflected in as nearly as possible the same proportion; but in passing across the fibres in going and returning, they suffer very unequal absorption on the part of the colouring matter, so that in the aggregate of the light perceived the different components of white light are present in proportions widely different from those they bear to each other in white light itself, and the result is a vivid colouring.

There are, however, cases in which the different components of white light are reflected with different degrees of intensity, and the light becomes coloured by regular reflection. Gold and copper may be referred to as examples. In ordinary language we speak of a soldier's coat as red, and gold as yellow. But these colours belong to the substances in two totally different senses. In the former case the colouring is due to absorption; in the latter case to reflection. In the same sense, physically speaking, in which a soldier's coat is red, gold is not yellow, but blue or green. Such is, in fact, the colour of gold by transmission, and, therefore, as the result of absorption, as is seen in the case of gold leaf, which transmits a bluish green light, or of a weak solution of chloride of gold after the addition of protosulphate of iron, when the precipitated metallic gold remains in suspension in a finely-divided state, and causes the mixture to have a blue appearance when seen by transmitted light. In this case we see that while the substance copiously reflects and intensely absorbs rays of all kinds, it more copiously reflects the less refrangible rays, with respect to which it is more intensely opaque.

All metals are, however, highly opaque with regard to rays of all colours. But certain non-metallic substances present themselves which are at the same time intensely opaque with regard to one part of the spectrum, and only moderately opaque, or even pretty transparent, with regard to another part. Carthamime, murexide, platino-cyanide of magnesium may be mentioned as examples. Such substances reflect copiously, like a metal, those rays with respect to which they are intensely opaque, but more feebly, like a vitreous substance, those rays for which they are tolerably transparent. Hence, when white light is incident upon them, the regularly-reflected light is coloured, often vividly, those colours preponderating which the substance is capable of absorbing with intense avidity. But perhaps the most remarkable example known of the connexion between intense absorption and copious reflection occurs in the case of crystals of permanganate of potash. These crystals have a metallic appearance, and reflect a greenish light. They are too dark to allow the transmitted light to be examined; and even when they are pulverised, the fine purple powder they yield is too dark for convenient analysis of the transmitted light. But the splendid purple solution which they yield may be diluted at pleasure, and the analysis of the light transmitted by it presents no difficulty. The solution absorbs principally the green part of the spectrum; and when it is not too strong, or used in too great thickness, five bands of absorption, indicating minima of transparency, make their appearance [these were shown on a screen]. Now, when the green light reflected from the crystals is analysed by a prism, there are observed bright bands indicating maxima of reflecting power, corresponding in position to the dark bands in the light transmitted by the solution. The fifth bright band, indeed, can hardly, if at all, be made out, but the corresponding dark band is both less strong than the others and occurs in a fainter part of the spectrum. When the light is reflected at a suitable angle, and is analysed both by a Nicol's prism, placed with its principal section in the plane of incidence, and by an ordinary prism, the whole spectrum is reduced to the bands just mentioned. The Nicol's prism would under these circumstances extinguish the light reflected from a vitreous substance, and transmit a large part of the light reflected from a metal. Hence we see that as the refrangibility of the light gradually increases, the substance changes repeatedly, as regards the character of its reflecting power, from vitreous to metallic and back again, as the solution (and, therefore, it may be presumed, the substance itself) changes from moderately to intensely opaque, and conversely.

These considerations leave little doubt as to the chemical state of the copper present in a certain glass which was exhibited. This glass was coloured only in a very thin stratum on one face. By transmission it cut off a great deal of light, and was bluish. By reflection, especially when the colourless face was next the eye, it showed a reddish light visible in all directions, and having the appearance of coming from a fine precipitate, though it was not resolved by the microscope, at least with the power tried. It evidently came from a failure in an attempt to make one of the ordinary red glasses coloured by suboxide of copper, and the only question was as to the state in which the copper was present. It could not be oxide, for the quantity was too small to account for the blueness, and, in fact, the glass became sensibly colourless in the outer flame of a blow-pipe. Analysis of the transmitted light by the prism showed a small band of absorption in the place of the band seen in those copper-red glasses which are not too deep; and, therefore, a small portion of copper was present in the state of suboxide—*i.e.*, a silicate of that base. The rest was doubtless present as metallic copper, arising from over-reduction in the manufacture, and accordingly the blue colour, which would have been purer if the suboxide had been away, indicates the true colour of copper by transmitted light, quite in conformity with what we have seen in the case of gold. Hence, in both metals alike, the absorbing and the reflecting powers are, on the whole, greater for the less than for the more refrangible colours, the law of variation with refrangibility being of course somewhat different in the two cases.

Time would not permit of more than a very brief reference to the second property to which the speaker had referred as useful in tracing substances in impure solutions—that of fluorescence. The phenomenon of fluorescence consists in this, that certain substances, when placed in rays of one refrangibility, emit during the time of exposure compound light of lower refrangibility. When a pure fluorescent substance (as distinguished from a mixture) is examined in a pure spectrum, it is found that on passing from the extreme red to the violet and beyond the fluorescence commences at a certain point of the spectrum, varying from one substance to another, and continues from thence onwards, more or less strongly in one part or another, according to the particular substance. The colour of the fluorescent light is found to be nearly constant throughout the spectrum. Hence, when in a solution presented to us, and examined in a pure spectrum, we notice the fluorescence taking, as it were, a fresh start with a different colour, we may be pretty sure that we have to deal with a mixture of two fluorescent substances.

It might be inferred *à priori*, that fluorescence at any particular part of the spectrum would necessarily be accompanied by absorption, since otherwise there would be a creation of *vis viva*; and experience shows that rapid absorption (such as corresponds to a well-marked minimum of transparency indicated by a determinate band of absorption in the transmitted light) is accompanied by copious fluorescence. But experience has hitherto also shown, what could not have been predicted, and may not be universally true,[*] that conversely, absorption is accompanied, in the case of a fluorescent substance, by fluorescence.

From what precedes it follows that the colour of the fluorescent light of a solution, even when the incident light is white, or merely sifted by absorption, may be a useful character. To illustrate this, the electric light, after transmission through a deep-blue glass, was thrown on solutions in weak ammonia of two crystallised substances, æsculin and fraxin, obtained from the bark of the horse-chestnut, and of which the latter occurs also in the bark of the ash, in which, indeed, it was first discovered. Both solutions exhibited a lively fluorescence, but the colour was different, being blue in the case of æsculin and bluish-green in the case of fraxin. A purified solution obtained from the bark exhibits a fluorescence of an intermediate colour, which would suffice to show that æsculin would not alone account for the fluorescence of the solution of the bark.

When a substance possesses well-marked optical properties, it is in general nearly as easy to follow it in a mixture as in a pure solution. But if the problem which the observer proposes to himself be—Given a solution of unknown substances which presents well-marked characters with reference to different parts of the spectrum, to determine what portion of these characters belongs to one substance and what portion to another—it presents much greater difficulties. It was with reference to this subject that the second of the objects mentioned at the beginning of the discourse had been spoken of as that the attainment of which was by far the more difficult. The problem can in general be solved only by combining processes of chemical separation, especially fractional separation, with optical observation. When a solution has thus been sufficiently tested, those characters which are found always to accompany one another in, as nearly as can be judged, a constant proportion, may with the highest probability be regarded as belonging to one and the same substance. But while a combination of chemistry and optics is in general required, important information may sometimes be obtained from optics alone. This is especially the case when one at least of the substances present is at the same time fluorescent and peculiar in its mode of absorption.

To illustrate this the case of chlorophyll was referred to. An eminent French chemist, M. Fremy, proposed to himself to examine whether the green colour were due to a single substance, or to a mixture of a yellow and a blue substance. By the use of merely neutral bodies, he succeeded in separating chlorophyll into a yellow substance, and another which was green, but inclining a little to blue; but he could not in this way get further in the direction of blue. He conceived, however, that he had attained his object by dissolving chlorophyll in a mechanical mixture of ether and hydrochloric acid, the acid on separation showing a fine blue colour, while the ether was yellow. Now solutions of chlorophyll in neutral solvents, such as alcohol, ether, &c., show a lively fluores-

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[*] Fluorescent substances, like others, doubtless absorb the invisible heat-rays lying beyond the extreme red, in a manner varying from one substance to another. Hence, if we include such rays in the incident spectrum, we have an example of absorption not accompanied by fluorescence. But the invisible heat-rays differ from those of the visible spectrum (as there is every reason to believe) only in the way that the visible rays of one part of the spectrum differ from those of another, that is, by wave length, and consequently by refrangibility, which depends on wave length. Hence, it is not improbable that substances may be discovered which absorb the visible rays in some parts of the spectrum less refrangible than that at which the fluorescence commences; and *mixtures* possessing this property may be made at pleasure. Nevertheless, the speaker has not yet met with a pure fluorescent substance which exhibits this phenomenon.

cence of a blood-red colour; and when the solution is examined in a pure spectrum, the red fluorescence, very copious in parts of the red, comparatively feeble in most of the green, is found to be very lively again in the blue and violet. Now a substance of a pure yellow colour, and exercising its absorption, therefore, as such substances do, on the more refrangible rays, would not show a pure red fluorescence. Either it would be non-fluorescent, or the fluorescence of its solution would contain (as experience shows) rays of refrangibilities reaching, or nearly so, to the part of the spectrum at which the fluorescence, and therefore the absorption, commences; and, therefore, the fluorescent light could not be pure red, as that of chlorophyll is found to be even in the blue and violet. The yellow substance separated by M. Fremy, by the aid of neutral reagents, is, in fact, non-fluorescent. Hence, the powerful red fluorescence in the blue and violet can only be attributed to the substance exercising the well-known powerful absorption in the red, which substance must, therefore, powerfully absorb the blue and violet. We can affirm, therefore, *à priori*, that if this substance were isolated it would NOT be blue, but only a somewhat bluer green. The blue solution obtained by M. Fremy owes, in fact, its colour to a product of decomposition, which when dissolved in neutral solvents is not blue at all, but of a nearly neutral tint, showing, however, in its spectrum extremely sharp bands of absorption.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IX.—*Thursday, January* 21, 1864.

(*Continued from page* 186.)

We proceed to-day with the examination of the constituents of sea-water. The first of those which remain to be considered is boron, which exists in boracic acid. I informed you in the last lecture that Forchammer sought in vain for a long time to find boron directly in sea-water. Boracic acid salts may be discovered in dried sea-mud in closed natural basins. They have been, in fact, so discovered, as at Stassfurth, near Magdeburg. A very fine collection of specimens of this kind appeared in the Zollverein department of the Exhibition of last year, and we have a series of them in the museum. Ten pounds of sea-water from the sound of Copenhagen was evaporated to dryness; the residue was then melted in a platinum crucible, and washed well with water. This residue was seen under the microscope to be crystalline throughout. It consisted for the most part of gypsum, that is, a salt of lime. This was dissolved out with water, and the washing was continued until no further sulphuric acid could be detected. There are some very curious and interesting points connected with this experiment of Forchammer; in the residue he found small regular octahedral crystals consisting of periclase, that is, pure crystallised magnesia. The residue was now digested for some twenty-four hours with sal-ammoniac—chloride of ammonium. The octahedral crystals disappeared, and in the residue were found regular hexagonal prisms of apatite—phosphate of lime, and also some oblique prismatic crystals. Both were dissolved in hydrochloric acid, and decomposed by sulphuric acid, and then evaporated in a steam bath. By the solvent action of water containing 60 per cent. of alcohol, a solution was obtained which gave to turmeric the characteristic reaction of boracic acid, and the spirit burned green at the edges. We will show you this experiment, which is usually resorted to in order to detect the presence of boracic acid. Here, in this vessel, is some asbestos moistened with spirit in which boracic acid is dissolved. Upon gently heating the vessel, and igniting the spirit, the green flame of boracic acid will be produced.

By the evaporation of the spirit, small scales were actually obtained, having the appearance of boracic acid. After the solution of the borax and the phosphates contained in the residue of sea water, crystals remained undissolved, which, under the microscope, appeared to be pointed regular six-sided pyramids. They obstinately withstood the action of acids, and were found to be composed of alumina and peroxide of iron. No further investigation has been since made concerning the precise constitution of this crystalline body.

I think you will admit that it is an interesting fact that simply by the evaporation of sea water in this way, and the fusion of the residue, we should be able to obtain several distinct minerals; and I think you will also admit that the proof here advanced of the presence of boracic acid in sea-water is clear and conclusive.

I may say incidentally that this periclase—oxide of magnesium, or magnesia crystals—may be obtained by the prolonged action of lime on borate of magnesia in a porcelain furnace. It requires a high temperature, and long exposure thereto, to produce it. It has also been produced crystallised by the action of hydrochloric acid gas on magnesia, and also by the action of steam upon chloride of magnesium. That is an action not at all unlikely to occur in nature. The apatite has been produced crystallised by fusing a mixture of phosphate of soda, fluoride of calcium, and an excess of chloride of calcium; or by fusing a mixture of common amorphous phosphate of lime and chloride of sodium—common salt; or by fusing phosphate of lime with fluoride and chloride of calcium in a vessel of carbon; or by heating phosphate of lime in contact with chloride of calcium at a temperature of 250° Centigrade.

The next constituent we have to consider is a very interesting one, and that is silver. Careful experiments have been made to ascertain whether sea water contains silver or not. It would be impossible to bring before you all the details; but the result appears to be conclusive. Silver is there. It must be there, in fact. The chloride of silver, which is so insoluble of itself, is very sensibly soluble in aqueous solutions containing chlorides dissolved. It has been sought for on the metal of ships. It is exceedingly likely that we should find it on ships coated with copper, or with Muntz's metal, which is a variety of brass, consisting of copper and zinc. These metals, in contact with chloride of silver dissolved in sea water, by virtue of the presence of other chlorides, would decompose the chloride of silver, and we should have the silver thrown down upon the surface of the metal. Experiments of this nature, as well as others, have been made repeatedly, and seem to establish conclusively the fact of the presence of silver in sea water. Forchammer found it in the carbonate of lime of certain of the lower marine animals. I mentioned to you on the last occasion a singular fact concerning the presence of silver in some of our ironstones in South Wales.

Gold has been sought for in sea water, but not yet clearly detected. Many years ago we were engaged here in making some experiments concerning the extraction of gold and silver from lead. It occurred to us as possible that the sheathing metals of ships which have been long at sea might contain gold upon the surface. We examined some copper sheathing carefully and found gold thereon, but unfortunately this result was inconclusive, because we had not previously ascertained the absence of gold from copper, and I am quite sure it is much more frequently present in that metal than is generally supposed. The experiment was therefore entirely vitiated on that account. The presence of gold in sea water is a point well worthy of further search.

Copper has not been directly detected in sea water, but it has been found—and this is equally conclusive—in the carbonate of lime of sea animals and in the ashes of sea plants.

Lead has not been found directly, but has been discovered in the same way as copper in the same materials, but in much larger quantity. By the action of sea water upon lead chloride of lead is formed, which I have seen, in one case at all events, beautifully crystallised. This is a specimen which has been long immersed in sea water. I am now speaking of some years ago. It is covered with beautiful crystals of chloride of lead.

Zinc has not been immediately found in sea water, but it has been detected in comparatively considerable quantity by Forchammer in marine plants, especially in the *zostera marina* and also in the *fucus vesiculosus*, which is very common about our coasts.

The metals cobalt and nickel, which are so commonly associated in nature, have been sought for and found in the ashes of sea plants, but not directly in sea water.

Iron may be detected directly in the residue of the evaporation of sea water, and also in the ashes of sea plants, and in the secreted lime of sea animals.

Manganese is found along with iron in the ashes of the *zostera marina*, and especially in plants collected in the middle of summer, the ashes of which contained, according to Forchammer, so much oxide of manganese that the odour of chlorine was strongly developed when hydrochloric acid was poured upon them. The ashes of the *zostera marina* contain a comparatively very large proportion of the protoxide of manganese. It is said that the amount was even so much as 4 per cent.

Aluminium, after a good deal of trouble, was found by Forchammer, as I stated a short time ago, in the fused residue of the evaporated sea water from the sound of Copenhagen.

Magnesium is also a constituent of sea water. Magnesia is a very prominent compound in sea water. A very good way of estimating the proportions of the constituents of sea water is to take the chief constituent, which is chlorine, as a standard, and to estimate the quantity of the other bodies contained in it in relation to chlorine. We will take that standard as 100, as Forchammer has done. The relation of the magnesia to the chlorine is, by weight, 11,077. The presence of such a large quantity is explained by the fact that few chemical or other reactions occur in sea water to remove the magnesia; whereas we know, in reference to lime, that when lime has fallen into sea water it is very speedily appropriated by sea animals, and is very rapidly removed from the water. This is not the case with magnesia. Magnesia occurs in sea plants and animals, and in *serpula filigrana* Forchammer found as much as 13·49 per cent. of carbonate of magnesia.

Calcium is the next constituent to which I shall refer. Lime exists in sea water in very small quantity in combination with carbonic acid; in greater proportion with phosphoric acid and fluorine; and in greatest proportion of all with sulphuric acid. You see, then, that lime exists in several states of combination in sea water. Its combination with sulphuric acid is by far the most important for us to consider. Its relation to chlorine is 2·96 to 100. You see how much smaller the proportion of lime is than that of the magnesia compared with our standard of chlorine.

Barium is found always along with strontium. The sulphate of strontia was directly discovered by Forchammer in the evaporated residue of sea water, especially in the deposit of steam boilers. It was also met with in *fucus vesiculosus*, and along with it was baryta. The occurrence of strontia along with baryta in sea water is a very curious point.

Sodium, as we all know, is, of course, abundant in sea water in the form of chloride of sodium or common salt.

Potassium is also present, but in much smaller quantity than sodium.

Both lithium and arsenic are reported to have been discovered in sea water.

The total average amount of saline matter in water of the ocean is 1·811 per cent. Or, perhaps, the better way of taking it will be the quantity in the thousand parts, which will be 18·11. The maximum of saline matter was 18·14. It occurred near the equator, between Africa, Borneo, and Malacca. The minimum of saline residue was 18·06 in the thousand parts. It occurred between the Aleutian and Society Islands.

We will now direct attention to the relations between the chief constituents of sea-water, taking, as I said just now, 100 parts of chlorine as the standard. Sulphuric acid presents the relation of 11·89 to that standard; lime, 2·96; and magnesia, 11·07. This method of comparison with the chief constituent is, I think, a very instructive way of representing the quantity of the substances in sea-water. The relations I have given you apply to the water of the main—to ocean water. In the Baltic the following relation obtains:—Sulphuric acid, 12·77 (this is a larger proportion than in the water of the ocean); lime, 3.59; magnesia, 11·89. The water of the Kattegat and the Sound contains:—Sulphuric acid, 11·94; lime, 3·29; magnesia, 10·86. These differences are sensible when we come to estimate them in respect to a large amount of water.

	Sulphuric Acid.	Lime.	Magnesia.
In the North Sea the quantities are	12·05	2·87	11·25
,, Mediterranean ,, ,,	11·82	3·08	10·90

The differences now become very appreciable. The saline matter in sea-water decreases, in general, as one would expect, near the coast. It is subject to much variation, which depends greatly upon the flow of fresh water from the rivers. On the west coast of South America, where little or no water flows in this way from the land, this variation does not obtain. Between the water of the Baltic, which drains a great part of the north and east of Europe, and the water of the Mediterranean, the difference is very great. The Baltic contains proportionately less saline matter; and the water of the Mediterranean between the Straits of Gibraltar and the Grecian Archipelago, contains, on the average, 37·936 parts in the thousand of saline matter—that is, 3·7936 per cent. This is explained by the deficient supply of fresh water, and by the great evaporation caused by the hot, dry winds from Africa. In the corresponding part of the Atlantic Ocean, the proportion is 35·946 in the thousand; and in the tropical part of the Atlantic Ocean, between 30 degrees south of the equator, and 30 degrees north of the equator, the mean proportion is 36·321 in the thousand. In the Mediterranean, between the Island of Candia and the African coast, the proportion is 39·257—a very sensible difference—about three parts in the thousand. The double stream in the Strait of Gibraltar has, of course, long been known. The specifically lighter water of the Atlantic forms the upper current flowing in, and the specifically heavier water of the Mediterranean forms the deep water flowing out. In the Baltic there are double currents, but the reverse is true in respect to the direction of those currents. As a rule, the upper current flows out of the Baltic into the Kattegat, and the lower current from the Kattegat into the Baltic. The cause appears to be similar to that of the currents in the Mediterranean—the difference of the specific gravity between the water of the Baltic and that of the ocean, or that is one cause, at all events; but we find that the specific gravity of the two currents is exactly the reverse of what I stated with regard to the Mediterranean. I will give you some of the observations which have been made by Forchammer on this interesting point. In 1846, from April 27 to September 11, 19 observations were made on the deep current, and 134 on the upper current. In these 134 days the upper current came during 24 days from the north, and it contained on the average 15·994 in a thousand of solid residue. In 86 days, during which it came from the south, it contained on an average 13.342 of saline matter in a thousand. The ground current of the sound was observed once in every week, and it contained on the average 19·002 of saline matter in a thousand. You see that that is a great difference. The bottom current is sometimes very strong, and this is said to explain a phenomenon often observed—namely, that vessels of deep draught of water go against wind and the upper current, whilst vessels of less draught in vain attempt to bear up against those forces, the deep draught vessels reaching the lower current, which is very strong, and carries them against the upper current and the wind. In March, 1860, the temperature of the bottom current was 2·6 Centigrade at a depth of 108 feet, and that of the upper current 1·6 Centigrade. In the summer no difference of temperature was found between the two currents. The average proportion of saline matter in the water of the Polar currents from Baffin's Bay and Davis's Straits was 33·176 in the thousand. The quantity in the South Polar Ocean was 27·285. In the Atlantic Ocean, between the equator and the 30th degree of north latitude, it was 36·169. I give you simply a few illustrations.

The average composition of the solid ingredients of sea water at the surface, exclusive of the North Sea, the Baltic, the Mediterranean, and the Black Sea—that is, the water of the ocean generally—may be taken at 34·304. Then the chlorine will be 18·945; the sulphuric acid, 2·253; the lime, 0·561; and the magnesia, 2·096. Those are the most important ingredients. Taking the relations, according to our first plan of stating the proportions—that is, representing chlorine as 100—sulphuric acid will be 11·89; lime, 2·96; and magnesia, 1·07. This may be regarded as the relation existing between the chief constituents of the solid residue of general ocean water, exclusive of those seas which I have mentioned, and where certain local peculiarities obtain.

Much might be said with regard to the interesting fact of the variation in the proportion of saline matter at different depths, but I will give you a few observations only upon that subject.

The water of Baffin's Bay, taken from the surface, contained 33·594 of saline matter per thousand, and at a depth of 420 feet it contained 33·607, a trifle more than the water of the surface. At 59 deg. 45 min. north latitude, and 39 deg. 4 min. west longitude, surface water contained 35·067 per thousand, and at a depth of 270 feet the water contained 35·963, a sensibly larger amount. At 59 deg. 50 min. north latitude, and 7 deg. 52 min. west longitude, surface water contained 35·576; and at 270 feet deep the quantity was 35·462, a slight variation in the reverse direction, the surface water in the other instances I have mentioned containing a little less than the deep water. In the middle of the Atlantic ocean, surface water contained 36·196 of saline matter; and water from the greatest depth, I believe, at which water has yet been taken for examination, namely, 11,100 feet, contained 35·170. That is an interesting point—more than one part in a thousand less. I might give you a great number of further illustrations, but I should only weary you by detaining you for that purpose.

There are some curious points concerning the differences of condition in the deposition of saline matter from sea water. When a portion of the sea is separated from the rest of the ocean by a change of level, and more water is removed by evaporation than is supplied by rivers flowing into it, and no water flows out, there must, of course, be a gradual concentration of the water, and finally the deposition of all the salts. When under similar conditions there is an outflow, but less in amount than the inflow, salts must in course of time be deposited, but in this case the least soluble will be deposited—such as gypsum and chloride of sodium—and the less soluble will be washed away. Some curious observations were made some years ago by Balard, the discoverer of bromine; and upon these observations he attempted to establish certain important operations. I will give you the main results, as they really have an important geological bearing, and show how one salt after another may be deposited by spontaneous evaporation at given degrees of density.

When the water of the Mediterranean was concentrated by spontaneous evaporation to the specific gravity of 1·27, common salt only was deposited. The mother-liquor or the bittern by further concentration by spontaneous evaporation, first deposits, as its specific gravity rises to 1·32, a mixed salt consisting of about 40 parts of sulphate of magnesia, or Epsom salts, and 60 of common salt; or if the temperature falls to 6 or 7 degrees centigrade—that is, to 43 or 45 degrees Fahrenheit—the bittern of the specific gravity of 1·32 deposits sulphate of magnesia nearly pure. About 90 kilogrammes—that is, nearly 200 lbs. weight, were obtained from a cubic metre of water of this specific gravity. The bittern concentrated to 1·345 specific gravity by spontaneous evaporation, after the deposition of the magnesian salt, deposits a double chloride of potassium and magnesium. When this is dissolved in a small quantity of hot water, the chloride of potassium crystallises nearly pure on cooling. The bittern of the specific gravity of 1·345 contains much chloride of magnesium. The greater part of the sulphate in sea-water separates as sulphate of soda when the liquid is concentrated from the specific gravity of 1·152 to 1·2, if cooled down to 4 or 5 degrees below zero centigrade—that is, 23 or 25 Fahrenheit. Those are, no doubt, very curious points, capable of application by geologists in explaining those remarkable saliferous deposits which we find in different parts of the earth. I might refer to an experiment made some years ago, in which salts were formed upon this principle. There were specimens in the Exhibition of 1862, and there are fine specimens in this museum. At Stassfurth, saline deposits have been found in which one salt after another has been produced, no doubt by spontaneous evaporation. I will just call your attention to them incidentally. There is a very curious one called carnalite, consisting of one part of chloride of potassium, two of chloride of magnesium, and twelve of water. There is another called kisserite, which is a sulphate of magnesia containing water—one atom only. Then there is the salt called stathfurthite, which is a compound of borate of magnesia and chloride of magnesium. All these occur in these curious deposits, which were no doubt produced by evaporation under special conditions, such as those to which I have drawn your attention.

(To be continued.)

ACADEMY OF SCIENCES.

April 25.

M. **Peligot** communicated a memoir "*On the Organic Matters contained in Water.*" The author's experiments were made with the waters supplied to Paris, and the results are mainly interesting to the Parisians; but one or two things are worthy of notice here. M. Peligot points out that certain metallic salts, perchloride of iron among them, precipitate organic matters, and act as powerful disinfectants. The action of the iron salt is most marked and rapid; but the proportion of the salt added must be carefully adjusted to the amount of mineral matter contained in the water; for in the presence of a great excess no precipitate will be formed. The deposit formed is a compound of ferric hydrate and oxide of iron with organic matter resembling the crenic and apocrenic acids of Berzelius. We may quote the method by which the author separated urea from sewer water. He evaporated the water to dryness, treated the residue with absolute alcohol, and evaporated the alcoholic solution to dryness. The latter residue he then dialysed, evaporated the diffusate, added nitric acid to the residue, and so obtained crystals of nitrate of urea. M. Peligot remarks that we very much overestimate the rate at which organic matters in solution decompose; and his own belief accords with that of Vauquelin, who showed forty years ago that urea broke up very slowly in water.

M. Robinet read a memoir "*On the Means of Increasing the Salubrity of Large Towns.*" The author's suggestion is one which was made here long ago, namely, to ventilate drains and sewers by means of openings in communication with furnaces and high chimneys.

M. Th. Harnitz Harnitsky presented a memoir "*On the Synthesis of Chloride of Benzoyl and Benzoic Acid.*" When benzoic acid is distilled with an excess of caustic alkali, it breaks up into carbonic acid and benzine. The author has succeeded in effecting the inverse reaction. He passed oxychloride of carbon and the vapour of benzine into a retort heated and exposed to sunlight, and collected the products. After the separation of unaltered benzine from these, he obtained a liquid boiling at 198° which had a penetrating odour and irritated the eyes and lungs, it burnt with a luminous very smoky flame, sank in water, and in the water gradually formed a crystalline mass. These crystals proved to be benzoic acid, and the liquid from which they separated was chloride of benzoyl. The author is endeavouring to obtain the homologues of benzoic acid by similar means.

M. A. Lallemand presented a note "*On the Cyanides of Copper and some of their Combinations.*" The note relates principally to the double cyanides of copper and alkalies.

M. Bobierre communicates some "*Researches on the Chemical Composition of Rain-water Collected at Different Heights.*" The author's experiments were made at Nantes, where he collected the water on the observatory tower, and near the ground. The results of the examination of these waters are curious and interesting. They show that the rain-water collected in large towns varies much in composition. We can only find space for the mean results. The ammonia found in the water near the ground was always greatly in excess of that in the water collected on the tower. A little more nitric acid was present in the water collected above. The chlorine was about the same in both. The author remarks that a chemical examination of rain-water is an easy way of proving the vitiation of the atmosphere.

M. Blondlot sent a note "*On the Purification of Arsenical Sulphuric Acid.*" The author objects to the process of MM. Bussey and Buignet which we lately published, that some nitric acid may be left in the sulphuric, and that sulphate of ammonia might reduce arsenic acid to arsenious which would pass over as before. He therefore recommends that peroxides of manganese should be used to oxidise the arsenious acid. The way he proceeds is as follows:—Peroxide of manganese is added in the proportion of four to five grammes to the kilogramme of sulphuric acid, and the mixture heated to boiling in a porcelain dish, stirring all the time. The mixture is allowed to cool, and is then transferred to a retort and distilled. M. Blondlot has distilled to dryness acid so treated, and never found a trace of arsenic in the distillate.

NOTICES OF BOOKS.

The Prescriber's Pharmacopœia: Containing all the Medicines in the British Pharmacopœia of 1864, *&c., &c.* By a Practising Physician. Fifth Edition. London: Churchill and Sons, 1864.

In this book the remedies in the Pharmacopœia are classed according to their properties, *e.g.*, as acids (antalkalines), alkalies (antacids), astringents, errhines, sialagogues, masticatories, &c. We have often wondered what sort of prescribers can want a book of this kind, and imagined the hopeless bewilderment of one who referred to it. The only useful thing we can see in the work is the doses appended to each medicine, and it would have been much more rational to have given the articles in their alphabetical order with simply the dose added.

We give a specimen of the contents, that our readers may form their own opinion. Under the head vegetable tonics we find,—

"Decoctum cinchonæ flavæ.

"Comp. cinchona flava, 1 oz.; water, 20 oz. (boil). Dose, fl. oz. fl. oz. 2.

"Incomp. lime water, tartar emetic, sulphate of iron."

That is the sort of information which a "Practising Physician" thinks will be useful to his professional brethren; and we need not waste our space in showing the deficiencies of it.

Botany for Novices: a Short Outline of the Natural System of the Classification of Plants. By L. E. B. London: Whittaker and Co. 1864.

This is a book, the execution of which we can warmly praise as far as it goes. It is, however, a book for novices, being simply an attempt to explain the principles of the natural system, and therefore dealing but with the simplest rudiments of botanical science. But though unpretending, it has the merit of great clearness, and the careful student will easily understand, and be able to determine, the class and subclass to which any flower he may examine belongs, which, though not going very far in the natural system, is necessarily the beginning of botanical study. We can heartily recommend the book to those for whom it has been written, namely, "those who have no previous acquaintance with botanical science," and join in the hope of the writer, "that it may introduce its readers to a more extended study of the subject."

The Economical Use of Fuel, and the Prevention of Smoke in Domestic Fireplaces; with observations on the Patent Laws. By Frederick Edwards, Jun. London: Hardwicke. 1864.

Last year Sir William Armstrong rather frightened the nation with his idea of the rapid exhaustion of our coal-fields, and the waste of coal in our domestic fireplaces. The public mind soon quieted itself again. People said to themselves "The coal will last my time," and nobody thought of pulling down his house, and building another with narrower chimneys, and supplied with grates upon the most approved principles. So the waste still goes on, and increases with every house built.

The author of this book does well to recall public attention to the subject; but we do not expect his present effort will be very successful. The book seems to us a mistake. A very interesting little work might have been written on the principles involved in the economical use of fuel in the warming of our dwellings, and such a work we have no doubt would have met with a success which this notice of several inventions for producing a smokeless fire will hardly command. We advise the author to reconsider the matter, and to give us simply an account of the firegrate he recommends, and the principles involved in its construction and use, so that the public and builders may understand the subject. It is a matter well deserving attention, for it seems that more than a million a year goes up our chimneys in the form of smoke, only to pollute the atmosphere and begrime the neighbourhood.

At the conclusion of his book the author makes an onslaught on the patent laws, and advocates their entire abolition on grounds which, if we understand them, appear to us altogether insufficient. The patent laws are, no doubt, greatly abused, and require revision. But, except by a similar law, we do not see how a real inventor is to be secured a proper reward. In any reform of the law the object should be to guard against the public being imposed upon by sham inventors, who strive to appropriate well-known contrivances, such as the double window pane alluded to here by Mr. Edwards. The author seems to suppose that all the advantage a patent offers might be secured by a public exhibition of useful inventions, which many may think will afford excellent opportunities for copying the invention, without rewarding the inventor. It will be found useless, however, to argue against patents in face of the enormous fortunes which are known to be occasionally made by their means.

Annales de Chimie et de Physique, March, 1864.

This number, which we have just received, contains a learned paper, by M. Cazin, "*On the Valuation of Electro-dynamic Action in Unities of Weight*," which will no doubt receive much attention. M. Béchamp publishes a paper "*On the Existence of Several Odoriferous and Homologous Fatty Acids in the Fruit of the Gingko Biloba.*" He has found therein formic, acetic, propionic, butyric, valeric, caproic, and caprylic acids, butyric, acetic, and caproic predominating. A valuable paper "*On the Mutual Action of Oxides of Mercury on Salts with an Alkaline or Alkaline-Earthy Base*" we shall translate at length. The remainder of the number is made up of papers by M. Berthelot and others, which have already appeared in abstract in the Chemical News, but to which we may return when the learned societies now necessarily occupying much of our space adjourn for the vacation.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

286. William Watson and William Henry Watson, Leeds, York, "Improvements in the manufacture of blue colour for dyeing and other purposes."—Petition recorded February 3, 1864.

320. Marie Celeste de Casteras Sinibaldi, Greenwich, Kent, "Improvements in the manufacture of plates, tubes, cylinders, and other articles, and for covering or coating the same with copper, brass, or other metals."—Petition recorded February 6, 1864.

341. Brereton Todd, Falmouth, Cornwall, "Improvements in compositions to be used to prevent the oxidation of iron, the fouling of ships' bottoms, and other submerged things, and also for preserving wood from decay and worms."—Petition recorded February 9, 1864.

351. Marie Celeste de Casteras Sinibaldi, Greenwich, Kent, "Improvements in coating with copper, brass, or other metals the surfaces of ships and other structures of iron or steel."—Petition recorded February 10, 1864.

355. Thomas Vincent Lee, Macclesfield, Chester, "Improvements in the construction of kilns or retorts for coking, and for apparatus connected therewith for collecting the products of distillation through the agency of hydro-caloric or superheated steam; these appliances being applicable to making wood charcoal, and collecting pyroligneous acid during the process."—Petition recorded February 11, 1864.

603. Thomas Boyle, Gray's Inn Road, London, "An improved air and smoke valve."—Petition recorded March 10, 1864.

634. John Platt and William Richardson, Oldham, Lancashire, "Improvements in machinery or apparatus for breaking up or pulverising clay for the manufacture of bricks or other such articles, or for breaking up or pulverising other materials."—Petition recorded March 12, 1864.

668. James Carrick, George Square, Glasgow, N.B., "Improvements in apparatus for inhaling, breathing, and respiratory purposes."—Petition recorded March 16, 1864.

696. James Burrell, Back Church Lane, Whitechapel, London, "Improved apparatus to be used in combination with marine steam-boilers as a self-acting scum or brine cock and feed cock, which apparatus may also be used as a salinometer and water gauge."

698. George Kershaw, Park Street, Camden Town, London, "Improvements in macerating vessels."—Petitions recorded March 18, 1864.

699. Charles Heywood, Manchester, Lancashire, "An improved method and means of removing 'scum' or floating particles from the surface of water or other liquids."

700. David Jones, Birmingham, Warwick, "Improvements in sugar funnels or moulds."—A communication from Simon Labayen, Matanzas, Cuba.—Petitions recorded March 19, 1864.

713. John Morgan, Stephen's Green, Dublin, "Improvements in the preservation of animal and vegetable substances, and in the fluids to be employed therein."

716. George Firmin and Cornelius Firmin, Henley Rettory, near Ipswich, Suffolk, "Improvements in heating the contents of vats or tanks and other receptacles in steeping flax and hemp."—Petitions recorded March 21, 1864.

728. François Louis Roux, Abingdon Street, Westminster, "An improved plastic compound for the protection of metallic and non-metallic surfaces from the action of water, air, and other causes of deterioration."—Petition recorded March 23, 1864.

745. Charles Garton, Bristol, and Thomas Hill, Southampton, "Improvements in mashing apparatus."

746. Samuel Bark and Thomas Attwood, Smethwick, Stafford, and James David Robinson, Birmingham, Warwick, "Certain improvements in slides for gaseliers, as also in the means of regulating or stopping the flow of gas, parts of which improvements are also applicable to chandeliers where oil, camphine, or other inflammable liquids are used for illumination."—Petitions recorded March 24, 1864.

754. Richard Archibald Brooman, Fleet Street, London, "An improved method of, and improved apparatus for, revivifying animal black."—A communication from Jean Baptiste Felix Trolliet, Lyons, France.—Petition recorded March 26, 1864.

769. John Lightfoot, Accrington, Lancashire, "Improvements in dyeing and printing textile fabrics and yarns, and in fixing more permanently certain mordants thereon."

770. Michael Henry, Fleet Street, London, "Improvements in apparatus for supplying air to persons employed under water or in places where noxious gas, air, or vapour prevails."—A communication from Benoist Rouquayrol, Paris, France.—Petitions recorded March 28, 1864.

773. James Robbins, Howley Street, Lambeth, "New improved methods of, and apparatus for, treating various liquid and solid substances for the production of artificial liquid manures, for separating oils and other liquids from solids, and preparing or treating the solid ingredients for dry manures; the said apparatus, or parts thereof, being applicable for filtering, decanting, carbonising, pumping, drying, evaporating, and digesting generally."

775. Isaac Mark Evans, Ruabon, Denbigh, "Improvements in blasting for mining and other purposes, applicable also to discharging projectiles, and in the apparatus used in connexion therewith."

782. Arthur Heald, Sabden Whalley, Lancashire, "An improved composition for sizing yarns and threads."

783. Charles Doughty, Lincoln, "Improvements in treating a product obtained in refining the oil of cotton seeds."—Petitions recorded March 29, 1864.

786. Joseph Lang, Bolton-le-Moors, Lancashire, "Certain improvements in the ventilation of mines."

790. Thomas Waller, Fish Street Hill, London, "Improvements in apparatus for heating air, and in valves for admitting heated and cold air, and regulating the supply thereof."

791. Thomas James Smith, Twickenham, Middlesex, "Improvements in the purification, distillation, rectification, evaporation, condensation, concentration, and oxygenation of spirits and spirituous liquors, and in the

apparatus employed therein, and in raising and forcing the same; parts of which are applicable to the manufacture of vinegar, to the raising and forcing of liquids, to the heating, cooling, and oxygenating of beer and liquids, and to the construction of chimneys."—A communication from François Haeck, Brussels, Belgium.—Petitions recorded March 30, 1864.

801. James George Beckton, Whitby, Yorkshire, "Improvements in engines or machinery for forcing, blowing, or exhausting air and other gaseous fluids."

806. Richard Archibald Brooman, Fleet Street, London, "Improvements in gas generating apparatus."—A communication from E. F. A. Goguel, Audincourt, France.—Petitions recorded March 31, 1864.

809. James Hicks, Hatton Garden, London, "An improved maximum mercurial thermometer."

817. John James Lundy, Leith, N.B., and Robert Irvine, Musselburgh, N.B., "Improvements in the manufacture of paper."—Petitions recorded April 1, 1864.

820. Stephen William Silver, Bishopsgate Street Within, London, "The preparation of the milk gum, or juice of the sapota mulieri, or bullet tree."—A communication from John Thornborrow Manifold, Demerara, British Guiana.—Petition recorded April 2, 1864.

834. Leonard Cooke, Horwich, Lancashire, "Improvements in the manufacture of paper."—Petition recorded April 4, 1864.

841. Stephen Martin the younger, Sheffield, Yorkshire, and Edward Young, Oughtibridge, near Sheffield, "Improvements in the manufacture and application of fire-resisting cements and materials."

843. Napoleon Sarony, Broad Street, Birmingham, "Improvements in photography."

848. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of artificial fuel." A communication from François Celestin, Armelin, Paris, France.—Petitions recorded April 5, 1864.

856. Edward Thomas Hughes, Chancery Lane, London, "An improved controlling apparatus for registering the quantity and quality of alcohol obtained in distilleries." A communication from Trangott Glaeser, Brieg, and Ernst Hofmann, Breslau, Silesia, Prussia.

857. John Lightfoot, Accrington, Lancashire, "Improvements in sizing textile fabrics and yarns."—Petitions recorded April 6, 1864.

877. John Pickering, Spitalfields, London, "Improvements in refrigerators, or apparatus for refrigerating or cooling wort and other liquids."—Petition recorded April 7, 1864.

926. Auguste Audigier, Marseilles, France, "Embalming and mummifying dead bodies."

928. John Campbell Evans and John Calvin Thompson, East Greenwich, Kent, "Improvements in preserving the bottoms of iron and other ships and vessels."

931. James Neilson and James Gillies, Glasgow, N.B., "Improvements in apparatus for fixing or closing capsules on bottles and other vessels."—Petitions recorded April 13, 1864.

Notices to Proceed.

3069. Frederick Piercy, Dartmouth, Devon, "Improvements in the application of heat to water and other fluids, and in apparatus for the same."—Petition recorded December 7, 1863.

3089. Peter Hubert Desvignes, Lewisham, Kent, "Improvements in apparatus for exhibiting dissolving views."—Petition recorded December 8, 1863.

3123. John Corby, Dunoon, Argyle, N. B., "Improvements in centrifugal machines for extracting the syrups from sugar."

3133. Richard Archibald Brooman, Fleet Street, London, "Improvements in machinery for grounding or colouring wall paper and other fabrics."—A communication from Richard McMauree, New York, U.S.—Petitions recorded December 11, 1863.

3136. Thomas Clayton, Manchester, "Improvements in generators for making gas from volatile fluids."

3145. John Platt and William Richardson, Oldham, Lancashire, "Improvements in the preparation of clay for the manufacture of bricks, tiles, and other articles which may be made of such material."

3146. Walker Thomas Whitmore Jones, Holles Street, London, "Improvements in apparatus to be applied to lamps."—Petitions recorded December 12, 1863.

3154. Eugène Rascol, Brydges Street, London, "Improvements in the manufacture of glass."—A communication from M. Tony Petitjean, Geneva, Switzerland.—Petition recorded December 14, 1864.

33. Joshua Kidd, Cannon Row, Westminster, "Improvements in supplying and regulating any required liquid used in the process of generating gas or steam, or for the carburating of gas, for supplying and regulating the water to gas-meters, and oil for lubrication, and in apparatus connected therewith."—Petition recorded January 5, 1864.

746. Samuel Bark and Thomas Attwood, Smethwick, Stafford, and James David Robinson, Birmingham, Warwick, "Certain improvements in slides for gaseliers, as also in the means of regulating or stopping the flow of gas; parts of which improvements are also applicable to chandeliers where oil, camphine, or other inflammable liquids are used for illumination."—Petition recorded March 24, 1864.

817. John James Lundy, Leith, N. B., and Robert Irvine, Musselberg, N.B., "Improvements in the manufacture of paper."—Petition recorded April 1, 1864.

931. James Neilson and James Gillies, Glasgow, N. B., "Improvements in apparatus for fixing or closing capsules on bottles and other vessels."—Petition recorded April 13, 1864.

CORRESPONDENCE.

Continental Science.

M. Martins has given an account of the desert of Sahara, from which the following may be extracted:—He divides it into three parts—1st, the desert of the plateaux, which are large surfaces covered with gypsum, which have resisted the erosive action of water, both modern and deluvian; 2nd, the desert of erosion; 3rd, the desert of sand, which is formed of heaps of sand resembling the waves of the sea suddenly rendered immovable, terminated by sharp angles, by rounded domes, or by sharp points: these waves of sand are covered by a thin vegetation of shrubs and of grasses, which disappears entirely in those parts where the sand is blown about under the influence of the wind. An oasis he describes as a plantation of date palms. These have been greatly increased in number since the introduction of artesian wells.

The following process, by M. Dumas, for ascertaining the richness of crude crystallised sugar is given:—One litre of alcohol of 85° and 50 grammes of acetic acid of 8° are mixed; as much pure sugar as the liquid will dissolve is then added. A decilitre of this liquid is mixed with 50 grammes of the sugar to be tested, and after filtering the liquid, the areometer is placed in it, when every degree lost by the alcoholometer corresponds to a degree of diminution in the richness of the sugar, unless the sugar is very impure, when the variable nature of the impurities renders this kind of assay a little less certain; but for the sugars ordinarily found in the market satisfactory results are obtained.

In Cosmos there is mentioned a new process of tanning, by which a great saving in time and expense is effected. There is also an account of an improvement, by M. Hempel, in the construction of balances for very accurate weighings. It consists in the employment of a needle, which is fixed on a vertical axis projecting upwards from the beam for the ultimate adjustment of the weight.

At the Academy of Sciences of Vienna, M. Hlasiwetz gave an account of an unfinished investigation which he has undertaken, together with M. Barth, upon the resins. M. Felineck presented specimens of a yellow dust which had fallen from the atmosphere in the environs of Breslau over a space of more than 350 square miles. M. Kuez communicated some interesting details of the existence of the thymus gland, of which the function is still unknown.

MISCELLANEOUS.

Chemistry at the College of Physicians.—It is right to state that the error ascribed to Dr. Farre, in a paragraph with the above heading, which we extracted from a contemporary last week, appears to have been a mistake on the part of the reporter.

Royal Institution. — Monday, May 9, at two o'clock, general monthly meeting. Tuesday, May 10, at three o'clock, Professor Marshall, "On Animal Life." Thursday, May 12, at three o'clock, Mr. Hullah, "On Music (1600—1750)." Friday, May 13, at eight o'clock, Mr. J. Scott Russell, "On the Mechanical History of Gun Cotton." Saturday, May 14, at three o'clock, Professor Frankland, "On the Metallic Elements."

Decay of Stone at the Houses of Parliament.—During the past week some experiments have been undertaken with the view of testing the merits of several suggestions which have been submitted to the Chief Commissioner of Works, or described in evidence taken before the Royal Commission in 1861. For the purposes of this practical trial similar portions of the ornamental stonework on the east, west, and north faces of the building were selected, and placed at the disposal of the following gentlemen, for treatment according to their respective processes. All these stone surfaces exhibited signs of decay in about an equal degree, and underwent a cleaning process at the hands of the several operators as a necessary preliminary to applying their chemical solutions. Five small gablets on the west front of the palace (facing Westminster Abbey) were allotted respectively to Mr. Dudley, representing the Fluo-silicic Company; Messrs. Rust and Co., of Lambeth; Messrs. Bartlett, Brothers, of Camden Town; Mr. J. Spiller, of Woolwich; and Mr. A. H. Church, of Cirencester. In a similar manner portions of several buttresses on the river front and north return of the palace were made the subject of experiment under conditions of almost absolute equality as regards the extent of their disintegration. The nature of the materials which have been applied cannot be stated with certainty, but we gather, chiefly from the minutes of evidence already published, that they are composed as follows:—Messrs. Rust and Co. and Messrs. Bartlett advocate the use of recently mixed preparations containing an alkaline silicate in association with a soluble compound of alumina and potash. Messrs. Rust and Co. consider the employment of a small quantity of lime in addition to be advantageous, but whether this should exist in solution, or merely in suspension, appears yet to remain an open question. Mr. Spiller employs an aqueous solution of biphosphate of lime, which is said to have the power of hardening and closing the structure of all calcareous building-stones. Mr. Church has patented the use of the alkaline earths in combination with aqueous silica, prepared by dialysis, for indurating the surfaces of all kinds of stone. The chemical agent employed by the Fluo-silicic Company cannot be defined with certainty; the use of the acid itself seems, however, more probable than that of any of its ready-formed compounds. In addition to these, we understand that Mr. Young is about to apply paraffin to another portion of stone, and Mr. De Wylde to employ his patent solution of "allotropic alumina" with a neutral alkaline silicate. The weather has been very favourable throughout the whole period occupied in the application of these processes; and the public will watch with interest the indications afforded by these competitive trials.

French Cement.—This cement, composed of lime and india-rubber, is very valuable for mounting large microscopical preparations. The principal advantages are—that it never becomes perfectly hard, and thus permits considerable alteration to take place in the fluid contained in the cell without the entrance of air, and it adheres very intimately to glass, even if it be perfectly smooth and unground. If a glass cover is to be affixed to a large cell containing fluid, a small piece of the cement is taken between the finger and thumb and carefully rolled round until it can be drawn out into a thread about the eighth or tenth of an inch in thickness; this is applied to the top of the cell, before introducing any fluid, and slightly pressed down with the finger previously moistened. It adheres intimately. The preservative fluid with the preparation are now introduced, and the cell filled with fluid, which indeed is allowed to rise up slightly above the walls. The glass cover, rather smaller than the external dimensions of the cell, and slightly roughened at the edges, is to be gently breathed upon, and then one edge is applied to the cement, so that it may be allowed to fall gradually upon the surface of the fluid until it completely covers the cell, and a certain quantity of the superfluous liquid is pressed out. By the aid of any pointed instrument a very little cement is removed from one part, so that more fluid may escape as the cover is pressed down gently into the cement. The pressure must be removed very gradually, or air will enter through the hole. A bubble of air entering in this manner may often be expelled again by pressure, or it may be driven out by forcing in more fluid through a very fine syringe at another part of the cell, but it is far better to prevent the entrance of air in the first instance. The edge of the glass cover being thoroughly embedded in the cement, the small hole is to be carefully plugged up by a small piece of cement, and the cell allowed to stand perfectly still for a short time, when it may be very gently wiped with a soft cloth. The edges of the cement may be smoothed by the application of a warm iron wire, and any superabundance removed with a sharp knife. A little Brunswick black or other liquid cement may be applied to the edges for the purpose of giving the whole a neater appearance. The cement is made as follows:—A certain quantity of india-rubber scraps is carefully melted over a clear fire in a covered iron pot. When the mass is quite fluid, finely powdered lime, having been slacked by exposure to the air, is to be added by small quantities at a time, the mixture being well stirred. When moderately thick, it is removed from the fire and well beaten in a mortar, and moulded in the hands until of the consistence of putty. It may be coloured by the addition of vermilion or other colouring matter. This cement answers well for fixing on the glass tops of large preparation jars, but if moderately strong spirit be used a little air must be permitted to remain in the jar.—*From "How to Work with the Microscope," by Lionel S. Beale.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

A Student.—We do not think that oxalate of lime has any commercial value. In answer to the third question, "In what way could a student utilise oxalate of lime himself?" we might suggest that he should burn it, and make his lime water from the residue.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Reciprocal Action of the Oxides of Mercury and Salts with an Earthy or Alkaline-Earthy Base, by M. J. Fonberg.*

The oxides of mercury are generally regarded as weak bases, this opinion being supported by the acid reaction of their salts, not only those corresponding to neutral salts but even those of a basic character, and also by the fact that these salts are easily decomposed by alkalies and alkaline earths. Rose, however, has endeavoured to prove † that the oxides of mercury cannot take an oxacid from an alkaline or alkaline-earthy base, nor a halogen from a corresponding metal. But the assertion of Rose is far from true, since experiment has proved that these oxides have the power of removing halogens from all the alkaline metals without exception; and further, that they act in the same way, though in a less degree, on the oxysalts of the alkalies and alkaline earths.

Before entering upon these experiments it should be mentioned that mercurous oxide, carefully washed and dried in the shade, acts uniformly upon mercuric oxide, and whether in or out of contact with air, the equivalent Hg_2O changes into an equivalent HgO and an equivalent of metal. The latter separates as the action of the protoxide proceeds in such a manner that the final result in the two cases is always the same.

The way to make the experiment upon one or other of the oxides is very simple. It is sufficient to place them in a test tube with a perfectly neutral solution of a salt and shake them together for some moments. With a saturated solution of a haloid salt of an alkaline or alkaline-earthy base the reaction is prompt, and the filtered liquid will show the presence of free alkali, while the presence of mercury is easily seen.

On heating a mixture containing an excess of haloid salt in relation to the quantity of oxide of mercury, the proportion of alkali or alkaline earth, and consequently the proportion of mercuric chloride, iodide, or bromide increases. The free base in the filtered liquid is easily discovered by turmeric paper, &c., and the mercuric compound may be shown by sulphuretted hydrogen, stannous chloride, metallic copper, or even by ammonia.

The mutual action of these chlorides, iodides, and bromides upon the oxides of mercury may be represented by equations, of which the following are examples:—

$$m\mathrm{KCl_2} + \mathrm{HgO} = \mathrm{KO} + \mathrm{HgCl_2} + (m - 1)\mathrm{KCl_2}.$$

$$m\mathrm{KCl_2Hg_2O} = \mathrm{KO} = \mathrm{HgCl_2} + \mathrm{Hg} + (m - 1)\mathrm{KCl_2},$$

Similar equations will represent the action of other haloid salts. For example:—

$$m\mathrm{NaBr_2} + \mathrm{HgO} = \mathrm{NaO} + \mathrm{HgBr_2} + (m - 1)\mathrm{NaBr_2}.$$

It may be objected that all these reactions are only results depending on the simple solution of oxide of mercury in water, but the author has convinced himself that such is not the case, and the following experiments will prove that the solubility of the mercuric oxide does not occasion the phenomena. When an oxide of mercury is boiled for a minute or two with perfectly neutral chloride of barium, the oxide of barium can be easily removed from the filtered solution by means of a current of carbonic acid. If the liquid be examined after the separation of the carbonate of baryta, it is found that the mercuric chloride is in solution joined with the undecomposed chloride of barium. The chlorides of calcium and strontium give analogous results. When operating with chloride of ammonium, boiling must of course be avoided when it is wished to obtain the ammonia in the same liquid in which it is formed. The products of decomposition are precisely similar to those in the preceding cases.

But if chloride of ammonium be boiled with mercuric oxide for half-an-hour in a retort fitted with a well-cooled receiver, the oxide completely disappears, and is entirely changed into corrosive sublimate. In this way we obtain separately a strong solution of ammonia in water in the receiver, and in the retort chloride of ammonium and mercury. Mercurous oxide gives analogous results, with the difference that an equivalent of mercury separates.

When operating in the same way with a haloid salt of an alkaline or alkaline-earthy metal, complete decomposition can only be effected when the salt is in large excess, but it may be effected more promptly by passing simultaneously a current of carbonic acid to remove the oxide formed. This is better applied to the salts of the alkaline-earths, particularly to that of barium. In this case the whole of the oxide of mercury dissolves in the form of chloro-mercurate of barium, while the carbonate of baryta forms a white powder at the bottom. With the chloride of magnesium the carbonic acid is unnecessary, since an oxide of magnesia gradually forms and separates spontaneously.

It only remains to add that these changes are not confined to the haloid, but extend to the oxy-salts, both inorganic and organic; but in these cases the decomposition is very limited. The difference is probably owing to the fact that the oxy-salts of the alkalies do not form double salts with mercuric oxide.

TECHNICAL CHEMISTRY.

On the Preparation and Purification of Benzole, by M. E. Kopp.

I have elsewhere mentioned the superheating process by which we have succeeded, more or less perfectly in converting the heavy tar oils, and which are frequently much charged with napthaline, into lighting gas and volatile oils rich in benzole.

The apparatus for this transformation consists of a horizontal retort of cast iron or earthenware, so arranged that it can be heated to incipient redness by the furnace flame and gases circling round it. One extremity of the retort is formed by a cover, easily adjusted and removed, giving access to the interior, and allowing of the necessary frequent cleaning out of the retort.

At a certain distance from the other well-closed extremity is a partition half the height of the retort, intended to prevent the flow of oil outside the retort.

Beyond this partition the retort communicates with a water chamber by means of a tube placed at the most inclined part of the side.

The lower part of the water chamber communicates by a hydraulic syphon with a waste pipe placed at its extremity, serving to collect the heavy and little volatile oils which condense in this water chamber. But the upper part of the chamber is, moreover, in communication with a good refrigerator of the usual construction, into which pass the more volatile products, which there separate into light oils, which condense, and are collected apart, and into lighting gas, which flows into a gasometer. The operation is conducted in the following manner:—

The retorts (a series of which may be placed in the same

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* Abridged from *Annales de Chimie et de Physique*, March, 1864, p. 300.

† *Poggendorff's Annalen*, vol. vi., p. 298 (1859).

furnace, and which may communicate with the same water chamber and the same refrigerator) having been heated to clear redness, a continuous thread of heavy oil is poured into them by means of a syphon attached to the exterior part of each retort, and terminating high up, with a funnel to receive the oil from a tap connected with a reservoir above.

As the oil flows into the retorts, it is rapidly affected by the high temperature, which modifies, at least, to a certain extent, its composition and its properties. The result is, more or less, graphitous or light charcoal, which remains in the retort, and more or less volatile oils and gaseous hydrocarbons.

As the volatile and gaseous products penetrate into the water chamber, a first separation is effected, then in this chamber are condensed the heavy and little altered oils, which must afterwards be again passed through the red hot retort; the more volatile products also traverse the refrigerator, where are condensed the light oils produced in the operation, which, rectified in an ordinary alembic, furnish light volatile and colourless oils, rich in benzole.

For the more perfect purification of benzole (or benzine), I propose taking advantage of its property of solidifying under the influence of cold, taking the form of flakes, grouped like fern leaves, or in crystalline masses similar to camphor, melting only at 8°·5 above 0°. For this purpose we cool the rough benzine to—15° in M. Carré's refrigerator, strongly and rapidly press the benzine crystals still impregnated with other liquid hydrocarbides, and thus, with the greatest ease, we obtain crystallised benzine, which, again melted and once more submitted to the same treatment, gives us benzine almost chemically pure.

With such a benzine a pure nitro-benzine may be obtained, very useful in perfumery, and with which perfectly pure aniline may be prepared.

But we doubt whether, in the manufacture of artificial colouring matters, the preparation of chemically pure benzine, nitro-benzine, and aniline, is of so much practical importance as might have been expected; unless, indeed, we can at the same time offer to manufacturers toluol, nitrotoluol, toluidine, and homologous products, so that they can operate on mixtures giving the most advantageous results as much with respect to the beauty and richness of the colour as with respect to the yield.[*]

After separating the benzine by congelation from light and volatile hydrocarbides, in no case must the mother liquors be mixed with the residues.

On the contrary, they must be treated as if the benzine were still present, and hence perhaps the names toluine, nitrotoluine, and commercial toluidine.

Such a separation and classification will, no doubt, facilitate the preparation and classification of anilines most suitable for various red, violet, and blue tints, and will contribute an important step to the theory of the formation of these colouring matters.—*Moniteur Scientifique*, vi., 329.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read:—"Chlorophosphide of Nitrogen. By Dr. Gladstone. "Constitution of Wood Spirit." By Mr. Dancer. "Apparatus for Gas Analysis." By Drs. Williamson and Russell. "Atomic Weights of Metals." By Dr. Williamson.

PHARMACY, TOXICOLOGY, &c.

On Atropine, by M. PFEIFFER.

Same Subject, by MM. KRAUT *and* LUDWIG.

HAVING, in conjunction with M. Ludwig, ascertained that atropine, when distilled with bichromate of potash and sulphuric acid, induces the formation of benzoic acid, M. Pfeiffer found that by boiling with soda this alkaloid gave rise to a volatile base and an acid, with a very high equivalent.

A similar result was at the same time obtained by M. Kraut, who, moreover, determined the composition and the principal properties of both these products. To the base he gives the name of tropine, the acid he calls atropic acid; but it yet remains unascertained whether these products are identical with those obtained by M. Pfeiffer.

By heating atropine to 100° with baryta water in a closed vessel, M. Kraut found that the alkaloid decomposed, producing a salt of baryta which, in presence of hydrochloric acid, divides into a crystallisable acid and an organic hydrochlorate, which remains in solution; the latter contains the tropine—

$$\underbrace{C_{34}AgH_{23}O_6}_{\text{Atropine.}} + 2HO = \underbrace{C_{18}H_8O_4}_{\text{Atropic acid.}} + C_{16}\underbrace{AgH_{17}O_4}_{\text{Tropine,}}.$$

Atropic acid crystallises in beautiful needles concentrically grouped, fusible at 105°·5. They form a salt of lime losing over sulphuric acid 13·94 per cent. of water. These properties differ from those of cinnamic acid ,with which atropic acid is isomeric.

Atropate of tropine is not crystallisable, is viscous at the ordinary temperature, and liquefies by heat. It does not seem to dilate the pupil.

Hydrochloric acid with heat divides atropine in the same way as does baryta water.

Hydrochlorate of tropine is soluble in water and crystallisable. With oxide of silver it becomes alkaline, and the liquid no longer seems to contain tropine. The same hydrochlorate is precipitated by bichloride of platinum, is soluble by heat, and then crystallises in beautiful orange crystals.

With chloride of gold it forms an equally crystallisable double salt.—*Journal de Pharmacie et de Chimie*, xlv., 282.

PHOTOGRAPHY.

Theoretical and Practical Researches on the Formation of Positive Photographic Proofs, by MM. DAVANNE *and* GIRARD.

PHOTOGRAPHIC images, especially those known as positive proofs, are the result of remarkable transformations, which might, unless properly studied, be considered anomalies. In each new operation the colour, clearness, intensity, and solidity of the result may be very considerably varied, without the cause of the variations being apparent. These hitherto unexplained transformations may, nevertheless, be classed with ordinary chemical reactions. This is what we have endeavoured to prove by a series of researches extending over six years.

To produce a positive proof the photographer takes a sheet of paper, covered with a sizing of albumen, gelatine, or starch, impregnates it with a soluble chloride, and then submits it to the sensitive action of a solution of silver. The image is then ready for insolation; placed under a negative plate it reproduces inversely

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[*] See CHEMICAL NEWS, vol. viii., p. 4:—Dr. Hofmann's "Memoir on the necessity of Mixing Aniline and Toluidine to produce Aniline Red."

the most delicate details. At this moment it is very brilliant, but will fade if not fixed by reagents, which dissolve the unacted on salts; and its coloration would be confined to the red tints given by contact with the fixers were it not finally submitted to the action of the colouring liquids called toning agents.

These successive operations require all the attention of the chemist; we have followed them step by step, and each has revealed to us some new facts, of which we will give a succinct *résumé*.

On Paper.—It is a fact well known to photographers that proofs prepared under the same conditions, but on papers of different origin, produce tones varying extremely. The cause of these variations arise from the influence exercised by the sizing of the photographic papers. A proof on unsized paper when taken from the fixing bath is always grey and flat; while on gelatinised, albuminised, or starched paper, it always has red brilliant tone, increasing in vigour with the abundance of the sizing. In this case a combination takes place between the sizing and the silver compounds, and this combination, a true lake colour, manifests its influence towards the finishing of the proof. The fact may easily be directly demonstrated: a mixture of chloride and nitrate of silver long exposed to the light, then heated with hyposulphite of soda, leaves as residue a grey metallic powder; while the same mixture, with the addition of gelatine, albumen, or starch, gives, under the same circumstances, a matter which gradually dries under the form of a brilliant red varnish, and which is found, on analysis, to contain carbon, hydrogen, and nitrogen. This argento-organic lake plays a considerable part in obtaining a photographic image; we shall have fresh occasion to appreciate its importance when investigating the causes of the alteration of the proofs.

The Salting.—The first operation which the paper undergoes is the imbibition of a soluble chloride; for this purpose chloride of sodium is usually employed, but certain authors recommend various other metallic chlorides, attributing special qualities to them. We have shown that the differences in action of these chlorides are more apparent than real; they are always to be ascribed to the varying excess of acid with which the salts are impregnated. With any chloride very various colouring may be obtained; mixed with an excess of acid or alkali, this chloride will always give a redder tinge than if employed in a neutral state; the natural explanation of this result is to be found in the normal action of acids and alkalies on the organic matters employed for sizing.

On Rendering Sensitive.—Chlorinated and dried, the paper is then placed on a bath of nitrate of silver; three things result from this, and the sensitive surface on coming from this bath is formed of chloride of silver, of a combination of gelatine, albumen, or starch, with nitrate of silver, and, lastly, of an excess of free nitrate of silver. The presence of these three substances is indispensable to the production of a good proof; chloride of silver alone gives but a dull and superficial image, but it produces the image rapidly; nitrate in excess gives the necessary depth to this image, and the argentico-organic lake gives it the characteristic red colour. The sensitivising bath may vary in richness, and we have carefully studied the effect of these variations; it may be neutral acid or alkaline; in the two latter cases the effect is the same as if the acid or alkali had been added to the chloride bath.

On Insolation.—To determine the effect of light on the sensitive surface, the composition of which we have given, is certainly, from a theoretical point of view, the most important part of our researches. It is universally admitted that chloride of silver exposed to the solar rays undergoes decomposition and disengages part of its chlorine; but the question is really much more complex than at first appears, and it is necessary to ascertain not only what becomes of the chloride, but also what becomes of the argentico-organic combination of free nitrate.

First as to the chloride. It has long been thought that light reduced this body to the state of sub-chloride Ag_2Cl. We have shown that such is not the case, and we stated that the decomposed chloride separates entirely as chlorine and metallic silver. We have established this, the principal point, by first proving that the product of the action of light on chloride of silver is soluble in hot nitric acid, while the essential property of the sub-chloride Ag_2Cl is its insolubility in this re-agent, and that this product, freed by hyposulphite of soda from the unreduced chloride of silver, contains no trace of chlorine.

It has certainly been objected to this last proof that hyposulphite of soda used as a fixing agent might have decomposed the sub-chloride Ag_2Cl into chloride $AgCl$, which would there dissolve into metallic silver; but the only good experiment cited in support of this hypothesis is the change in the colour of the insolated proof when placed in contact with the fixing agent. Now, we have ascertained that this change of colour is due to quite another cause, to a hydratation of the argentico-organic lake, and that this result is to be obtained by simply exposing the proof to the vapours of boiling water. Chloride of silver, then, is transformed by the action of light into chlorine and metallic silver.

It is the disengagement of chlorine from this decomposition which makes nitrate of silver play so important a part in positive photography. Thus, as we have already observed, a proof obtained with chloride of silver only is always tame and ineffective; in presence of excess of nitrate, on the contrary, it acquires great brilliancy. This result is easily explained; in fact, the action of light on a uniform surface of chloride of silver is soon limited by the opaque layer produced by the superficial reduction of the argentic compound; but if this compound is mixed with free nitrate of silver then, beside the portions reduced, and under the influence of the chlorine, they disengage, there are formed new quantities of chloride, which may then be attacked by light, because before this, in the state of nitrate, these portions occupied a particular place, and the reduced silver did not hitherto recover them; so that instead of a dull image several excessive layers are formed, which give to the design the required depth.

At the same time that the chloride of silver is reduced to a metallic state the argentico-organic combination is also reduced, forming a sort of insoluble lake, which, hydrating by contact with alkaline fixers, communicates a very pronounced red colouring to the proof.

The applications of these fixers is the second phase in the manipulations required in positive photography.—*Comptes-Rendus*, lviii., 634.

Royal Institution.—Tuesday, May 17, at three o'clock, Professor Marshall, "On Animal Life." Thursday, May 19, at three o'clock, J. Hullah, Esq., "On Music (1600—1750)." Friday, May 20, at eight o'clock, James Nasmyth, Esq., "On Day and Night in the Moon." Saturday, May 21, at three o'clock, A. Herschel, Esq., "On Falling Stars."

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 18, 1864.

H.R.H. The Prince of Wales, *Vice-Patron, in the Chair.*

A paper by John Tyndall, Esq., F.R.S., Professor of Natural Philosophy, Royal Institution, was read on "*Contributions to Molecular Physics.*"

The speaker had already shown the enormous differences which exist among gaseous bodies, both as regards their power of absorbing and emitting radiant heat. When a gas is condensed to a liquid, or a liquid congealed to a solid, the molecules coalesce, and grapple with each other by forces which were insensible as long as the gaseous state was maintained. But, though the molecules are thus drawn together, the luminiferous ether still surrounds them: hence, if the acts of radiation and absorption depend on the individual molecules, they will assert their power even after the state of aggregation has been changed. If, on the contrary, their mutual entanglement by the force of cohesion be of paramount influence in the interception and emission of radiant heat, then we may expect that liquids will exhibit a deportment towards radiant heat altogether different from that of the vapours from which they are derived.

The first part of the present inquiry is devoted to an exhaustive examination of this question. The speaker employed twelve different liquids, and operated upon five different layers of each, which varied in thickness from 0·02 of an inch to 0·27 of an inch. The liquids were enclosed, not in glass vessels, which would have materially modified the heat, but between plates of transparent rock-salt, which but slightly affected the radiation. His source of heat throughout these comparative experiments consisted of a platinum wire, raised to incandescence by an electric current of unvarying strength. The quantities of radiant heat absorbed and transmitted by each of the liquids at the respective thicknesses were first determined. The vapours of these liquids were subsequently examined, the quantities of vapour employed being proportional to the quantities of liquid traversed by the radiant heat. The result of the comparison was that, for heat of the same quality, the order of absorption of liquids and of their vapours are identical. There was no exception to this law; so that, to determine the position of a vapour as an absorber or radiator, it is only necessary to determine the position of its liquid.

This result proves that the state of aggregation, as far, at all events, as the liquid stage is concerned, is of altogether subordinate moment—a conclusion which will probably prove to be of cardinal importance in molecular physics. On one important and contested point it has a special bearing. If the position of a liquid as an absorber and radiator determine that of its vapour, the position of water fixes that of aqueous vapour. Water had been compared with other liquids in a multitude of experiments, and it was found that, as a radiant and as an absorbent, it transcends them all. Thus, for example, a layer of bisulphide of carbon 0·02 of an inch in thickness absorbs 6 per cent., and allows 94 per cent. of the radiation from the red-hot platinum spiral to pass through it; benzol absorbs 43 and transmits 57 per cent. of the same radiation; alcohol absorbs 67 and transmits 33 per cent., and alcohol stands at the head of all liquids except one in point of power as an absorber. The exception is water. A layer of this substance, of the thickness above given, absorbs 81 per cent, and permits only 19 per cent. of the radiation to pass through it. Had no single experiment ever been made upon the vapour of water, we might infer with certainty from the deportment of the liquid that, weight for weight, this vapour transcends all others in its power of absorbing and emitting radiant heat.

The relation of absorption and radiation to the chemical constitution of the radiant and absorbent substances was next briefly considered. For the first six substances in the list of those examined, the radiant and absorbent powers augment as the number of atoms in the compound molecule augments. Thus, bisulphide of carbon has three atoms, chloroform five, iodide of ethyl eight, benzol twelve, and amylene fifteen atoms in their respective molecules; and the order of their power as radiants and absorbents is that here indicated; bisulphide of carbon being the feeblest, and amylene the strongest of the six. Alcohol, however, excels benzol as an absorber, though it has but nine atoms in its molecule; but, on the other hand, its molecule is rendered more complex by the introduction of a new element. Benzol contains carbon and hydrogen, while alcohol contains carbon, hydrogen, and oxygen. Thus, not only does the idea of multitude come into play in absorption and radiation — that of complexity must also be taken into account. The speaker directed the particular attention of chemists to the molecule of water; the deportment of this substance towards radiant heat being perfectly anomalous, if the chemical formula at present ascribed to it be correct.

Sir William Herschel made the important discovery that, beyond the limits of the red end of the solar spectrum, rays of high heating power exist which are incompetent to excite vision. The speaker has examined the deportment of those rays towards certain bodies which are perfectly opaque to light. Dissolving iodine in the bisulphide of carbon, he obtained a solution which entirely intercepted the light of the most brilliant flames, while to the extra-red rays of the spectrum the same iodine was found to be perfectly diathermic. The transparent bisulphide, which is highly pervious to the heat here employed, exercised the same absorption as the opaque solution. A hollow prism filled with the opaque liquid was placed in the path of the beam from an electric lamp, the light-spectrum was completely intercepted, but the heat-spectrum was received upon a screen and could be there examined. Falling upon a thermo-electric pile, its presence was shown by the prompt deflection of even a coarse galvanometer.

What, then, is the physical meaning of opacity and transparency as regards light and radiant heat? The luminous rays of the spectrum differ from the non-luminous ones simply in period. The sensation of light is excited by waves of ether shorter and more quickly recurrent than those which fall beyond the extreme red. But why should iodine stop the former and allow the latter to pass? The answer to this question no doubt is that the intercepted waves are those whose periods of recurrence coincide with the periods of oscillation possible to the atoms of the dissolved iodine. The elastic forces which separated these atoms are such as to compel them to vibrate in definite periods, and, when these periods synchronise with those of the ethereal waves, the latter are absorbed. Briefly defined, then, transparency in liquids as well as in gases is synonymous with discord, while opacity is synonymous with accord between the periods of the waves of ether and those of the molecules of the body on which they impinge. All ordinary transparent and colourless substances owe their transparency to the discord which exists between the oscillating periods of their molecules and those of the waves of the whole visible spectrum. The general discord of the vibrating periods of the molecules of compound bodies with the light-giving waves of the spectrum may be inferred from the prevalence of the property of transparency in compounds, while their greater harmony with the extra-red periods is to be inferred from their opacity to the extra-red rays. Water illustrates this transparency and opacity in the most striking manner. It is highly transparent to the luminous rays, which demonstrates the incompetency of its molecules to oscillate in the periods which excite vision. It is as highly opaque to the extra-red undulation, which proves the synchronism of its periods with those of the longer waves.

If, then, to the radiation from any source water shows itself to be eminently or perfectly opaque, it is a proof that the molecules whence the radiation emanates must oscillate in what may be called extra-red periods. Let us apply this test to the radiation from a flame of hydrogen. This flame consists mainly of incandescent aqueous vapour, the temperature of which, as calculated by Bunsen, is 3259° C.; so that, if transmission augment with temperature, we may expect the radiation from this flame to be copiously transmitted by the water. While, however, a layer of the bisulphide of carbon 0·07 of an inch in thickness transmits 72 per cent. of the incident radiation, and while every other liquid examined transmits more or less of the heat, a layer of water of the above thickness is entirely opaque to the radiation from the flame. Thus we establish accord between the periods of the molecules of cold water and those of aqueous vapour at a temperature of 3259° C. But the periods of water have already been proved to be extra-red—hence those of the hydrogen flame must be extra-red also. The absorption by dry air of the heat emitted by a platinum spiral raised to incandescence by electricity was found to be insensible, while that by the ordinary undried air was 6 per cent. Substituting for the platinum spiral a hydrogen flame, the absorption by dry air still remained insensible, while that of the undried air rose to 20 per cent. of the entire radiation. The temperature of the hydrogen flame was, as stated, 3259° C.; that of the aqueous vapour of the air was 20° C. Suppose, then, the temperature of aqueous vapour to rise from 20° C. to 3259° C., we must conclude that the augmentation of temperature is applied to an increase of amplitude, and not to the introduction of periods of quicker recurrence into the radiation.

The part played by aqueous vapour in the economy of nature is far more wonderful than hitherto supposed. To nourish the vegetation of the earth the actinic and luminous rays of the sun must penetrate our atmosphere; and to such rays aqueous vapour is eminently transparent. The violet and the extra-violet rays pass through it with freedom. To protect vegetation from destructive chills the terrestrial rays must be checked in their transit towards stellar space; and this is accomplished by the aqueous vapour diffused through the air. This substance is the great moderator of the earth's temperature, bringing its extremes into proximity, and obviating contrasts between day and night which would render life insupportable. But we can advance beyond this general statement, now that we know the radiation from aqueous vapour is intercepted, in a special degree, by water, and, reciprocally, the radiation from water by aqueous vapour; for it follows from this that the very act of nocturnal refrigeration which produces the condensation of aqueous vapour upon the surface of the earth—giving, as it were, a varnish of water to that surface—imparts to terrestrial radiation that particular character which disqualifies it from passing through the earth's atmosphere and losing itself in space.

And here we come a question in molecular physics which at the present moment occupies the attention of able and distinguished men. By allowing the violet and extra-violet rays of the spectrum to fall upon sulphate of quinine and other substances Professor Stokes has changed the periods of those rays. Attempts have been made to produce a similar result at the other end of the spectrum to convert the extra-red periods into periods competent to excite vision—but hitherto without success. Such a change of period, the speaker agreed with Dr. Akin in believing, occurs when a platinum wire is heated to whiteness by a hydrogen flame. In this common experiment there is an actual breaking up of long periods into short ones — a true rendering of universal periods visual. The change of refrangibility here effected differs from that of Professor Stokes—firstly, by its being in the opposite direction—that is, from lower to higher; and secondly, in the circumstance that the platinum is heated by the collision of the molecules of aqueous vapour, and before their heat has assumed the radiant form. But it cannot be doubted that the same effect would be produced by radiant heat of the same periods, provided the motion of the ether could be rendered sufficiently intense. The effect in principle is the same, whether we consider the platinum wire to be struck by a particle of aqueous vapour oscillating at a certain rate or by a particle of ether oscillating at the same rate.

By plunging a platinum wire into a hydrogen flame we cause it to glow, and thus introduce shorter periods into the radiation. These, as already stated, are in discord with water; hence we should infer that the transmission through water will be more copious when the wire is in the flame than when it is absent. Experiment proves this conclusion to be true. Water from being opaque opens a passage to 6 per cent. of the radiation from the flame and spiral. A thin plate of colourless glass, moreover, transmitted 58 per cent. of the radiation from the hydrogen flame; but when the flame and spiral were employed, 78 per cent. of the heat was transmitted. For an alcohol flame Knoblauch and Melloni found glass to be less transparent than for the same flame with a platinum spiral immersed in it; but Melloni afterwards showed that the result was not general, that black glass and black mica were decidedly more diathermic to the radiation from the pure alcohol flame. The reason for this is now obvious. Black mica and black glass owe their blackness to the carbon diffused through them. This carbon, as proved by Melloni, is in some measure transparent to the extra-red rays, and the speaker had succeeded in transmitting between 40 and 50 per cent. of the radiation from a hydrogen flame through a layer of carbon sufficient to intercept the light of the most brilliant flames. The products of combustion of the alcohol flame are carbonic acid and aqueous vapour, the heat of which is almost wholly extra-red. For this radiation, then, the carbon is in a considerable degree transparent, while for the radiation from the platinum spiral, it is in a great measure opaque. By the introduction of the platinum wire, therefore, the transparency of the pure glass and the opacity of its carbon were simultaneously augmented; but the augmentation of opacity exceeded that of transparency, and a difference in favour of opacity remained.

No more striking or instructive illustration of the influence of coincidence could be adduced than that furnished by the radiation from a carbonic oxide flame. Here the product of combustion is carbonic acid; and on the radiation from this flame even the ordinary carbonic acid of the atmosphere exerts a powerful effect. A quantity of the gas, only one-thirtieth of an atmosphere in density, contained in a polished brass tube four feet long, intercepted 50 per cent. of the radiation from the carbonic oxide flame. For the heat emitted by solid sources olefiant gas is an incomparably more powerful absorber than carbonic acid; in fact, for such heat the latter substance, with one exception, is the most feeble absorber to be found among the compound gases. For the radiation from the hydrogen flame, moreover, olefiant gas possesses twice the absorbent power of carbonic acid, but for the radiation from the carbonic oxide flame, at a common tension of one inch of mercury, while carbonic acid absorbs 50 per cent., olefiant gas absorbs only 24. Thus we establish the coincidence of period between carbonic acid at a temperature of 20° C. and carbonic acid at a temperature over 3000° C., the periods of oscillation of both the incandescent and the cold gas belonging to the extra-red portion of the spectrum.

It will be seen from the foregoing remarks and experiments how impossible it is to examine the effect of temperature on the transmission of radiant heat if different sources of heat be employed. Throughout such an examination the same oscillating atoms ought to be retained. The heating of a platinum spiral by an electric current enables us to do this while varying the temperature between the widest possible limits. Their comparative opacity to the extra-red rays shows the general accord of the oscillating periods of our series of vapours with those of the extra-red undulations. Hence, by gradually heating a platinum wire from darkness up to whiteness, we gradually augment the discord between it and the vapours, and must therefore augment the transparency of the latter. Experiment entirely confirms this conclusion. Formic ether, for example, absorbs 45 per cent. of the radiation from a platinum spiral heated to barely visible redness; 32 per cent. of the radiation from the same spiral at a red heat; 26 per cent. of the radiation from a white-hot spiral, and only 21 per cent. when the spiral is brought near its point of fusion. Remarkable cases of inversion as to transparency occurred in these experiments. For barely visible redness formic ether is more opaque than sulphuric; for a bright red heat both are equally transparent, while, for a white heat, and still more for a nearly fusing temperature, sulphuric ether is more opaque than formic. This result gives us a clear view of the relationship of the two substances to the luminiferous ether. As we introduce waves of shorter period the sulphuric augments most rapidly in opacity; that is to say, its accord with the shorter waves is greater than that of the formic. Hence we may infer that the molecules of formic ether oscillate, on the whole, more slowly than those of sulphuric ether.

When the source of heat was a Leslie's cube filled with boiling water and coated with lampblack, the opacity of formic ether in comparison with sulphuric was very decided. With this source also the position of chloroform as regards iodide of methyl was inverted. For a white-hot spiral, the absorption of chloroform vapour being 10 per cent., that of iodide of methyl is 16; with the blackened cube as source the absorption by chloroform is 22 per cent., while that by the iodide of methyl is only 19. This inversion is not the result of temperature merely; for when a platinum wire, heated to the temperature of boiling water, was employed as a source, the iodide remained the most powerful absorber. All the experiments hitherto made by the speaker go to prove that from heated lampblack an emission takes place which synchronises in an especial manner with chloroform. For the cube at 100° C., coated with lampblack, the absorption of chloroform is more than three times that of bisulphide of carbon; for the radiation from the most luminous portion of a gas-flame the absorption by chloroform is also considerably in excess of that by bisulphide of carbon; while, for the flame of a Bunsen's burner, from which the incandescent carbon particles are removed by the free admixture of air, the absorption by bisulphide of carbon is nearly twice that by chloroform. The removal of the incandescent carbon particles more than doubled in this instance the relative transparency of the chloroform. Testing, moreover, the radiation from various parts of the same flame, it was found that for the blue base of the flame the bisulphide was the most opaque. For the radiation from a very small gas-flame, consisting of a blue base and a small white top, the bisulphide was also most opaque, and its opacity very decidedly exceeded that of the chloroform when the flame of bisulphide of carbon was employed as a source. Comparing the radiation from a Leslie's cube coated with isinglass with that from a similar cube coated with lampblack, at the common temperature of 100° C., it was found that, out of eleven vapours, all but one absorbed the radiation from the isinglass most powerfully; the single exception was chloroform. It may be remarked that, whenever, through a change of source, the position of a vapour as an absorber of radiant heat was altered, the position of the liquid from which the vapour was derived was changed in the same manner.

It is still a point of difference between eminent investigators whether radiant heat, up to a temperature of 100° C., is monochromatic or not. Some affirm this; some deny it. A long series of experiments has enabled the speaker to state that probably no two substances at a temperature of 100° C. emit heat of the same quality. The heat emitted by isinglass, for example, is different from that emitted by lampblack, and the heat emitted by cloth or paper differs from both. It is also a subject of discussion whether rock salt is equally diathermic to all kinds of calorific rays, the differences affirmed to exist by one investigator being ascribed by others to differences of incidence from the various sources employed. MM. de la Provostaye and Desains maintain the former view, Melloni and M. Knoblauch maintain the latter. The question was examined by the author without changing anything but the temperature of the source. Its size, distance, and surroundings remained the same, and the experiments proved that rock salt shares, in some degree, the defect of all other substances. It is not perfectly diathermic, and it is more opaque to the radiation from a barely visible spiral than to that from a white-hot one.

In regard to the relation of radiation to conduction. Defining radiation, internal as well as external, as the communication of motion from the vibrating molecules to the ether, the speaker arrives, by theoretic reasoning, at the conclusion that the best radiators ought to prove the worst conductors. A broad consideration of the subject shows at once the general harmony of the conclusion with observed facts. Organic substances are all excellent radiators; they are also extremely bad conductors. The moment we pass from the metals to their compounds we pass from a series of good conductors to bad ones. Water, among liquids, is probably the worst conductor; it is the best radiator. Silver, among solids, is the best conductor; it is the worst radiator. In the excellent researches of MM. de la Provostaye and Desains the author finds a striking illustration of what he regards as a natural law; that those molecules which transfer the greatest amount of motion to the ether, or, in other words, radiate most powerfully, are the least competent to communicate motion to each other, or, in other words, to conduct with facility.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture IX.—*Thursday, January* 21, 1864.

(*Continued from page* 224.)

I will conclude my remarks with reference to sea-water by presenting you with an analysis of the residue of two specimens. We will first take water near ourselves, and then compare it with the specimens from the western coast of South America. You will see that the two are not very dissimilar, although they are taken from places at a great distance from each other.

Solid Residue.

	Water from England.	Water from the Western Coast of South America.
Chloride of sodium .	. 74·20	75·80
Chloride of magnesium	. 11·04	8·80
Chloride of potassium	. 3·80	3·68
Bromide of potassium	. 1·09	1·23
Sulphate of lime .	. 4·72	4·54
Sulphate of magnesia.	. 5·15	5·88

There is a considerable difference between the chloride of magnesium in the two specimens. The proportion of residue of the water taken from England was 34·4 in the thousand, and the proportion of that of the other specimen was 32·8 in the thousand.

I will next call your attention very briefly to certain saliferous deposits. I might multiply here to a very great extent, but I am afraid to do so.

The first mineral to which I will call your attention is one of great interest. It is a very simple one, namely, thenardite. It is an anhydrous sulphate of soda, and it was found first of all near Madrid; specimens from South America have been brought over by Mr. Bullar. It is exquisitely crystallised, and singularly enough, it contained a little iodine in some form or other. We do not exactly know in what form, but on heating it in closed tubes iodine is evolved. We had it carefully analysed here some time ago. I mention this to show what an important indication with respect to temperature we may derive even from a small quantity of mineral like that. In this tube by the side of the natural mineral I have placed the artificial mineral. It is produced in the same form, and in all respects in the same way. When we can produce this artificial mineral we may naturally infer that similar conditions existed in the formation of the native mineral. There is another mineral termed glauberik, which is a double sulphate of soda and lime. It occurs in South America, and has two forms. It is associated especially with a very important mineral termed haysine (?), which is now a source of boracic acid.

The next important deposit is one which ought to have a lecture devoted exclusively to it, namely, gypsum. It is a compound of sulphuric acid and lime, and two equivalents of water. There is a ready source of gypsum in sea-water. It is a product of the decomposition of carbonate of lime by sulphuric acid. Suppose in some volcanic regions where sulphurous fumes are evolved those fumes come in contact with a rock containing lime and silica, and so on, the rock is attacked, and becomes a sulphate with certain other ingredients—it may be iron and alumina. From these we may obtain without difficulty sulphate of lime—a deposited crystallised sulphate of lime. Suppose we have first of all lime alumina and iron in that rock, we shall get sulphate of lime formed directly. We shall also get sulphate of iron and sulphate of alumina formed directly, and these coming in contact with a certain mineral water let fall immediately sulphate of lime. I may refer you for information on this interesting point to Bunsen's most remarkable paper on the pseudo-volcanic phenomena of Iceland, which is deserving of the most attentive study. He there speaks of the action exercised upon this plagonite rock, which consists essentially of silica, sesquioxide of iron, alumina, lime, magnesia, and so on. The facts which he mentions are very interesting as bearing on geology. Then we find gypsum frequently in connection with common salt, and with dolomite. In the slag there is one part where the connection is so intimate that they pass the one into the other by the most insensible gradations.

I had intended to speak at length on nitrate of soda, but I must defer that for the present.

We will now pass on to the consideration of a subject of the highest possible interest to us all, namely, carbon, which forms so large a part of the solid crust of the earth. It exists everywhere in the atmosphere as carbonic acid, in all limestone rocks in the form of carbonic acid in connection with lime, and in all organic matter—as wood, peat, and coal.

Carbon is known in three distinct chemical states. When speaking of silica I called your attention to three remarkable allotropic or elemental conditions of that substance, namely, an amorphous and two crystalline forms. We have a parallel series in the case of carbon. I spoke to you of the diamond-like silica. Carbon crystallises in the cubical or regular system, forming the well-known and magnificent gem, the diamond. It crystallises in the rhombohedral system, forming the mineral called graphite, which we can produce artificially, and well crystallised too. Then we have it in the amorphous state, with which every one is familiar.

Diamond occurs of various colours, and very beautiful colours they sometimes are. It is often not uniformly coloured throughout, the colour appearing to depend on enclosed foreign matter locally distributed. It has been found by Wöhler that green diamonds strongly heated became brown, whilst brown diamonds remained unchanged. At a very high temperature the diamonds became black, opaque, and coke-like, increasing at the same time in volume. Crystals and particles of gold have been found enclosed in diamonds. These are apparently exceedingly trifling points, but they are of enormous interest when viewed in connexion with the various theories which have been put forth to account for the formation of diamond. In the British Museum is a specimen of diamond containing an octahedral crystal of gold. I believe that in the museum at Rio (?) are diamonds upon which quartz crystals are distinctly impressed. Diamonds sometimes enclose other diamonds. In a diamond of Bahia minute yet distinct crystals similar to those of iron pyrites have been found to be enclosed, but the true nature of these crystals is at present only a supposition. They have not been clearly determined by chemical analysis to be iron pyrites, however probable it may be. It would, indeed, be a most interesting fact to be sure that a diamond did contain this bisulphide of iron enclosed, because facts like these, although they may not tell us exactly how to make the diamond, may tell us how it has not been made, and that is a very important consideration.

Many diamonds have been burned in oxygen gas for the purpose of chemical analysis, especially by Dumas and Stas in their determination of the atomic weight of carbon a good many years ago. I believe it was in 1841. They always found a residue. This residue sometimes formed a sort of spongy net-work of a reddish yellow colour; at other times it was in the form of crystalline straw-yellow particles; and sometimes it was colourless, and consisted of crystalline fragments. The same residues were obtained from large diamonds. The exact French expression is "very large" diamonds—*très gros;* they were well brushed and boiled for a long time with nitro-muriatic acid, which shows that there was no source of error from adhering foreign matter. On analysis the residue has been found to amount to about one-thousandth; it has been examined, and found to contain silica and iron, but the quantity on which we can operate is very small. It is a very expensive matter to get sufficient for the purposes of analysis. It is a very curious point that in these diamonds we should find both silica and iron. It has been maintained that an organic structure exists in this residue, and also in the diamond itself, but this is a point which has been carefully investigated by one of the best authorities in Europe, and the statement was found to have no foundation.

Now, for the occurrence of diamonds in nature, I may refer you to a most excellent paper on this subject—the best I have met with—which is to be found in the *Annales des Mines* for 1860. It is a translation by M. Delesse, of the German Geological Society, of a paper by MM. Heusser and G. Claraz on the occurrence of diamonds in Brazil. It is too long to give anything like proper extracts from, but I refer you to it with very great confidence. It abounds with information of the very highest interest.*

The diamond occurs, and is well known, in what is called itacolumite. This itacolumite is a quartsite, or a sort of soluble sandstone, granular and very friable, and often contains talc, chlorite, and mica. It almost always shows a schistose or slatey structure. The paper I have referred to gives all the details connected with this subject, and corrects the mistake with respect to the assertion that hornblende has been found in schist containing diamond. This is never the case. I should very much like to see this paper translated into English. I think it would interest a very large number of English readers. It is impossible to curtail it with anything like justice to it.

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* We shall shortly give an abstract of this important paper.—Ed. *C. N.*

There is in this paper a very curious point bearing upon a subject of now very great interest—the antiquity of man. The writer says:—"A very curious fact is the discovery in the cascalho—(that is, the stuff in which the diamond occurs)—of small fragments of quartz, having the form of an anvil. They have been polished, and have, no doubt, been made by the Indians, to whom they served as ear-rings." Then he says:—"The cascalho in which they have been found had not been previously worked in historical times and formed the bed of a river almost entirely dried up. It was found covered with more than six metres of vegetable soil, on which had grown magnificent palm trees." Then he goes on to say that the polished quartz articles were accompanied with other cut objects, such as arrow-points; and there were also bones, upon the nature of which they could not pronounce. He concludes from this that these remains demonstrate very great antiquity with regard to man. I do not know whether this particular passage has attracted the attention of those now occupied with this subject. If not, I should be glad to have an opportunity of bringing it before them.

Numerous theories have been put forth with regard to the formation of the diamond, and many experiments have been made on the subject. I need hardly tell you that in spite of the assertion which has been recorded that M. D. has made diamonds by electricity, there is no evidence to show the smallest trace of the diamond, crystallised in its cubical system, having been formed by man; but we are so sanguine about this matter that we cannot refrain from believing that one day or other the thing must be done. It assuredly will be done. We have apparently been very near it from time to time, but have never yet reached it.

Among the theories of the formation of the diamond, we are told by Liebig, for instance, that it is the final product of the decay of vegetable matter. That is a mere assertion. Diamond represents pure carbon, and so does graphite, so that in this respect the one stands in the same relation to this decay as the other. It is very strange that although this decay has been going on for thousands of years, we have not found diamonds where they would have occurred—in our coal measures. They are the last places where we should look for diamonds—at all events, for white diamonds. Even Dr. Wilson, of Edinburgh, took up this theory of Liebig; but I repeat that there is not the slightest foundation for such a statement concerning the formation of diamond in nature. Some of us have tried experiments extending over many years. We have taken bisulphide of carbon, a liquid possessing a highly refractive power, and perfectly limpid and colourless, and tried in vain to decompose it by the slow operation of a metal like silver acting during ten or twelve years, but there was not the slightest trace of carbon separated. It has seemed probable that the iodine compounds of carbon would furnish a likely means of enabling us to separate this wonderful mineral in a crystalline form, but no successful results have been obtained.

We shall resume this subject in the next lecture.

PHARMACEUTICAL SOCIETY.

May 4.

T. N. R. Morson, *Esq., in the Chair.*

Dr. De Vry communicated a paper "*On the Cinchona Cultivation in British India,*" which was read by Mr. Hanbury. After a six years' residence in Java, the author has obtained leave of absence for two years to recruit his health; and on his way home he made a visit to the British cinchona plantations in Ceylon and on the Neilgherry Hills in the Madras Presidency. Two systems of cultivation appear to be followed in the British possessions, one in dense forest shade, and the other in the open sunshine. In the Dutch settlement at Java the plants are grown in dense shade, and the author was anxious to investigate for himself the results of the cultivation in sunshine. In Ceylon he found the Cinchona Succirubra grown at an elevation of 1600 feet in the shade. The plants were healthy, and from 8 to 9 feet high. They were found to grow better in loftier situations, and the leaves in plants grown in high situations contained twice as much quinovic acid as in those grown in lower. An immense number of the Cinchona Succirubra plants are growing in Ceylon, some in sunshine and some in shade; and a plant thirty-one months old has attained a height of 10 feet and the circumference of 7 inches. At one station there were fifty-seven healthy plants of Cinchona Calisaya. The loss of plants by death, Dr. De Vry was surprised to learn, was only $\frac{1}{10}$th per cent. in Ceylon; in Java the average loss was 10 per cent. From Ceylon the author went to India, and visited Otacamund, where he found the plants under Mr. McIvor's charge in an excellent state. In three years the number has increased from 1000 to 248,166; and a most extraordinary instance of multiplication was seen in the case of the single specimen of C. Uritasinga, received eighteen months before from Mr. Howard, from which plant alone 4730 others had been obtained by cuttings and buds. It was noticed that plants from large cuttings were in a less satisfactory state than those from small. The plants were all healthy, and in this part were grown in open sunshine, which Mr. McIvor considers most favourable to their growth. Wherever he could, Dr. De Vry obtained specimens of leaves and the bark of both root and stem, and these he has submitted to analysis. His results are contained in an elaborate table, which was not read to the meeting. The author estimated the quinine, cinchonine, quinidine, and cinchonidine, and noticed another alkaloid, soluble in ether, which does not give the reactions of quinine, and which somewhat complicated the results. He also determined the quinovic acid in the leaves, which he considers an essential constituent of the cinchonas. Besides this acid, the leaves yielded traces of alkaloids, but not quinine. An experiment had been made to test the effects of thickening the bark by wrapping moss around the stem, and it had proved successful. The bark of a young plant so treated yielded 8·4 per cent. of alkaloids. One unexpected result obtained in Dr. De Vry's experiments was that the root bark was found to contain more of the alkaloids than the bark of the stem. In conclusion, the author expressed his belief that the cultivation of cinchona in India had proved a complete success, and that future results would show it as lucrative as it is now interesting in a scientific point of view.

Mr. Morson called attention to the circumstance of quinovic acid appearing in the plant before the quinine. In the poppy it had been noticed that meconic acid appeared long before morphia.

Mr. D. Hanbury, jun., thanked Dr. De Vry for his interesting communication, and remarked on the extraordinary increase in the number of plants, a single plant being increased to 4000 without seed.

Dr. De Vry said that Mr. McIvor preferred to propagate by cuttings, and not by seeds. He also starved the plants to compel them to make root, which would appear to be the most valuable part of the plant, for he had himself found eight times more alkali in the bark of the root than he had found in the bark of the stem. It might perhaps prove more useful to cultivate the plant for the root than the bark. Experiments were now in progress in Java to determine that point. He believed that the bark of the root of South American cinchona had been used in France.

Mr. Hanbury said that the root bark of the C. Calisaya had been imported into England, but although it was very cheap it would not sell.

Mr. Morson inquired whether quinovic acid possessed any medicinal properties?

Dr. De Vry replied that he believed it had; he had made experiments on the subject, and intended shortly to publish his results.

Professor Bentley said that Dr. De Vry's account of our cinchona plantations was very assuring. One fact mentioned, however, was at variance with a statement of Mr. Howard, who had asserted that the root bark of C. Calisaya only contained one-tenth of the alkaloids found bark of the stem. There was, of course, no question about the accuracy of Dr. De Vry's results, and it might be that the difference was owing to different ages of the plants.

Dr. De Vry said that the whole of his results had been confirmed by Delondre, with whom he had worked.

The next paper was "*On the Preparation of Syrup of Chloroform,*" by Mr. Groves. From the general and extensive use which is made of chlorodyne, the author infers that it has been found convenient to have a preparation from which chloroform does not easily separate on the addition of water. Chloroform is soluble only to the extent of two and a-half minims in an ounce of water, and when a spirituous solution is added to water any excess sinks rapidly to the bottom. Some time ago a Frenchman invented a syrup of chloroform and glycerine —a preparation which Mr. Squire soon showed to be absurd. It has also been proposed to mix chloroform and oil, and then emulsate with gum and sugar. Mr. Groves, however, has found that if the specific gravity of chloroform be reduced by the addition of a lighter fluid to the same specific gravity as a syrup, the two fluids will mix and remain together. The way to make such a mixture is as follows:—Into a twelve-ounce bottle put a fluid ounce of chloroform, and three fluid drachms of ether, and then add an ounce of syrup of honey. Shake these well together, and if any separation take place on standing add *guttatim* more ether until no separation takes place; then fill up the bottle with the syrup. A solution containing an eighth part of chloroform can be obtained, but the author considers the above preparation with one-twelfth preferable. Some physicians, however, prefer such a preparation as chlorodyne, which is miscible with water without separation of chloroform, or from which the chloroform separates in minute globules, easily shaken together again, and then remaining a long time in suspension. For such a preparation Mr. Groves gives the following formula:—Take of

Chloroform, four fluid drachms;
Ether, one fluid drachm and a-half;
Oil of peppermint, eight minims;
Extract of Indian hemp, sixteen grains;
Capsicum, two grains;

macerate these ingredients together for two days, then strain and add to the following solution, previously prepared:—

Muriate of morphia, sixteen grains;
Perchloric acid,
Water, of each half a fluid drachm;
Dilute hydrocyanic acid (Scheele's) 96 minims;
Syrup of treacle, one fluid ounce.

Dissolve the morphia in the syrup and perchloric acid with the aid of gentle heat, and when cold add the hydrocyanic acid. Finally, after mixing the above solutions, add syrup of treacle to make four fluid ounces. In this preparation prescribers will have the several ingredients in known proportions, an all important matter in the intelligent use of remedies. It only remains to add that the syrup of treacle may be replaced with syrup of honey, but the common syrup of sugar does not possess sufficient viscosity to answer well.

Professor Redwood then made a communication "*On Sulphuric Acid.*" The British Pharmacopœia, he said, gives directions for distillation of commercial sulphuric acid, and describes the result as monohydrated acid having the density 1·846. On a former occasion the Professor had said that the monohydrated acid could not be obtained in this way, and that if it could it was an objectionable preparation, since such an acid congeals at a low temperature, and remains solid up to 51° F. The exceptions which had been taken to this statement had led him to make some experiments, although it was a subject which he had before worked on largely. More than sulphuric acid was involved in the question; for, in the Pharmacopœia process for the preparation of glacial acetic acid, the strength of the sulphuric acid used will necessarily affect the strength of the resulting acetic acid; and the Professor had also stated that it was impossible to obtain glacial acetic acid by the Pharmacopœia process. That monohydrated sulphuric acid was not obtained by redistilling the ordinary acid had already been shown by Gay-Lussac, Marignac, Bineau, and the Professor had proved it in former experiments. He had, however, on that day made another experiment, following exactly the directions of the Pharmacopœia. He took 48 fluid ounces of a commercial acid, sp. gr. 1·843; to this he added 1 ounce of sulphate of ammonia, distilled over and rejected one-tenth, as ordered, and then proceeded with the distillation of the acid, collecting the product in fractional quantities of from 3 to 5 ounces. He then took the specific gravity of these several fractionnations, and found that in every instance he had an acid really weaker than that he started with, for the specific gravity never reached 1·842. No doubt one cause of the less density was the absence of foreign matters left behind in the distillation, such as sulphate of lead, which was always present in commercial acid, and the presence of which must necessarily augment the density. As regards the constitution of the distillate, it is quite certain that it is not monohydrated acid. This acid can only be obtained by freezing the Nordhausen acid. When procured, this acid is more glacial than acetic acid, remaining solid up to 51°. The specific gravity is 1·842. When heated, this acid partially decomposes, some anhydrous acid is driven off, and the water remains behind, rendering the residual acid weaker. It is seen, therefore, that the process, the name, and the characters of the acid given in the British Pharmacopœia are all inconsistent with each other. The process will not give the compound described, and the description will not apply to the acid designated. The process, in fact, gives one acid, the definition applies to another, and the characters apply to an acid perfectly distinct from both. Professor Redwood then made some remarks on the process for glacial acetic acid. He had stated that this acid also could not be obtained by the Pharmacopœia method, but it had been objected that he never used the sulphuric acid of the Pharmacopœia density. The only way of getting an acid of this density is to dilute Nordhausen acid with English oil of vitriol, and this he had done, and still could not obtain glacial acetic acid. There are two sources of failure: in the first place, the sulphuric acid contains more water than is necessary to form monohydrated acetic acid; and then there is the difficulty of completely drying the acetate of soda without decomposing it. The salt begins to decompose as soon as it fuses, and some carbonaceous matter is formed. When sulphuric acid is added to this, sulphurous acid is formed, and the water liberated goes to the acetic acid. It is true that glacial acid can be obtained from the Pharmacopœia product, but only by the subsequent process of submitting the distillate to a freezing mixture, draining the crystals, and repeating this operation once or twice. In conclusion, the Professor hoped that he had succeeded in establishing the truth of the statements he had at first made,—about which we think there cannot be the smallest doubt.

The Chairman announced that this would be the last meeting of the season.

Another Sewage Commission.—Lord Robert Montague has obtained a Committee of the House of Commons to consider the plans for utilising the sewage of large towns.

ACADEMY OF SCIENCES.—*May* 2.

In a long paper "*On the Disappearance of Combustible Gases Mixed with Oxygen during the Slow Combustion of Phosphorus,*" M. Boussingault details a lot of experiments which prove that carbonic oxide disappears under the above circumstances, and consequently that it is a bad way of estimating oxygen.

MM. Bussy and Buignet contributed a paper "*On Hydrocyanic Acid.*" The authors point out that when this acid is obtained by acting on equivalent proportions of cyanide of mercury and hydrochloric acid in the ordinary way only about two-thirds of the theoretical quantity of hydrocyanic acid can be procured. The obstacle to the disengagement of the acid they supposed to be the affinity of the corrosive sublimate formed; and they therefore employed an equivalent of chloride of ammonium to combine with the chloride of mercury and annul its influence. In this way they obtained 95 per cent. of the theoretical quantity of hydrocyanic acid. The authors proceeded to notice the changes of temperature with mixtures of real hydrocyanic acid and water, finding in no case a smaller decrease than 7·75°; and with one equivalent of acid and three equivalents of water—that is, equal weights of the two bodies—an abasement amounting to 9·75°. The change of volume was also greatest with these proportions; but singularly enough in this instance the abasement of temperature is attended with *decrease* of volume, the contraction in this instance amounting to 6·23 per cent. The authors account for this anomaly by the supposition of a molecular modification of the state of the hydrocyanic acid; but experimentally they can find no difference in the real acid and that with three equivalents of water. They determined that neither the anhydrous nor hydrated acid had any effect on polarised light, and that the indices of refraction gave no indication of change of state.

A note, entitled "*Researches on the Silico-Tungstic Acids,*" by M. Marignac, gives an account of some interesting bodies. Gelatinous silica boiled with an acid tungstate of potash or soda dissolves; the solution becomes alkaline, and now contains an acid in which one equivalent of silicic is combined with twelve equivalents of tungstic acid. The new acid the author designates *silico-tungstic acid.* It is a strong acid, very stable, which forms two hydrates obtainable in magnificent crystals. Acid tungstate of ammonia, under similar circumstances, gives an acid in which the equivalent of silica is united with ten equivalents of tungstic acid, and hence denominated *silico-decitungstic* acid. This acid is more difficult to separate, the hydrate does not crystallise, and on drying it easily parts with some of the silica, and forms a third acid—*tungsto-silicic*, in which the silica and tungstic acid are found in the same proportions as in silico-tungstic. It forms a soluble hydrate, and can be procured in crystals. All these acids are quadribasic; they are as soluble in alcohol as in water; and anhydrous ether forms with them a syrupy liquid miscible with water, but not with the excess of ether. The salts of these acids form with water solutions of extraordinary density. A solution of neutral silico-tungstate of soda, for example, having the sp. gr. 3·05, can be obtained, in which glass, quartz, and most stones will float, and yet is very fluid. [This solution, we may suggest, will form an excellent material for prisms.] Silico-tungstic acid crystallises with 29 eq. of water.—$SiO_2,12WO_3,4HO + 29$ aq. Tungsto-silicic acid crystallises with 20 eq. of water:—

$$12WO_3,SiO_2,4HO + 20 \text{ aq.}$$

The paper is full of interest, and we shall give it in detail.

Some of our readers may be interested to know that *the next appearance of Halley's comet* may be expected (according to the calculations of M. Pontecoulant, presented to the Academy at this meeting) on May 24, 1910.

M. Belhomme, we may mention, has ascertained by experiment that *the pollen of flowers* will retain its fecundating power as long as three years.

NOTICES OF BOOKS.

International Exhibition: Jurors' Report. Class II., Section A. Chemical Products and Processes. Reporter, A. W. Hofmann, F.R.S., LL.D., &c., &c.

(NINETEENTH NOTICE.)

(*Continued from page* 215.)

We are fast approaching the end of this important and interesting work, and shall now give but a brief notice of one or two remaining sections, leaving to a future occasion the elaborate essay on manures, which is placed nearly at the end, and which may be considered a distinct work.

Continuing the notice of organic manufactured products, we next come to starch. In this section the Reporter is unable to point out any recent discovery of paramount importance; but it is remarked that the manufacture of starch and its derivatives for food and technical purposes is far from having remained stationary during the last ten years. From the notice of the starch manufacture there is nothing to quote, but we extract a short account of an improved process for obtaining glutin from gluten followed by M. Scheurer Rott, of Thann. The gluten is macerated in water very slightly acidulated with hydrochloric acid. The proportions used are 1500 parts of gluten, 1000 parts of water, and one part of acid. Under this treatment the gluten gradually disintegrates and commences to dissolve. After twelve hours, acetic acid is added, to the amount of $\frac{1}{150}$th of the weight of gluten, and on agitating the mixture a homogeneous magma readily soluble in water is at last obtained. This solution is ready to be used in the printing of fabrics, on which, after steaming, the modified gluten becomes insolubly fixed. The reporter mentions that this new application of gluten has been proposed more especially with a view to the fixing of the aniline colours, but it appears that, as yet, it has been found impossible to prepare from gluten a glutin capable of replacing albumen in all its applications.

Horse-chesnut starch is now made in France by M. Callias on a manufacturing scale, and the only difficulty in the way of extending the industry is that of collecting the raw material. The chesnuts are rasped without previous decortication, and washed upon sieves. The liquid is allowed to settle, and the deposit is washed with water to which alum or sulphurous acid has been added. The bitter principle is soluble in water and alkaline solutions, and is thus removed by repeated washings. Horse-chesnuts are said to yield from 15 to 17 per cent. of starch, which is well suited for dressing, but less so for thickening colours.

Although we have given some account of the researches of M. Musculus in a former volume, we may quote a short paragraph relating to them from the Report, since they may be new to some of our readers, and the results are of importance. M. Musculus has found "that starch, when submitted to the action of boiling water acidulated with a few drops of sulphuric or hydrochloric acid, is not first converted into dextrine and then glucose, as has generally been believed. On the contrary, it splits simultaneously into dextrine and glucose, and the further transformation of the dextrine thus [qy. not] formed into glucose is by no means an easy operation. According to M. Musculus, it is almost impossible, by ebullition under the ordinary atmospheric pressure, however long continued, to convert starch entirely into glucose. This effect can only be produced by digestion at high pressure and temperature. This observation is especially important to distillers of alcohol from amylaceous substances, since dextrine is not susceptible of alcoholic fermentation."

A few words must suffice for a notice of Mr. F. O. Ward's process for separating the ingredients of mixed fabrics. We have already described it when commenting on the contents of the Exhibition, and shall here mention only the results. The fabrics (stuffs generally consisting of a cotton or flax warp and a woollen weft) are submitted to the action of steam for some hours at a pressure of from three to five atmospheres. The joint action of heat and moisture is to convert the animal matter into a friable substance, which retains its form, but crumbles to powder when handled. This, therefore, is removed by beating, and the vegetable fibre is then left in threads just as they formed the warp of the material treated. The vegetable fibre, is of course, applicable to paper making, and the altered animal matter constitutes a manure, which is here said to be more valuable than guano. It is called "ulmate of ammonia," described as a dark-coloured powder, which, in the soil, breaks up more readily than unaltered woollen rags, but not so suddenly as guano. An analysis by Dr. Voelcker shows it to contain nitrogen corresponding to 14·48 per cent of ammonia. Mixed with phosphates, it is said to produce a fertilising compost which leaves nothing to be desired. This is, unquestionably, an ingenious and valuable process.

Passing for a time the "Industry of Manures," we come to the last section of the Report, on "Objects of Scientific Interest." In this section the author refers principally to the results of spectrum analysis, introduced by a short account of the successive observations of the spectrum made by Newton, Wollaston, Wheatstone, and others, which led up to its application to analysis and the invention of the spectroscope.

On this part we need not dwell, as our columns for the last two years have teemed with communications on the subject.

Finally, Dr. Hofmann bestows a few words of well-merited praise on the interesting collections of M. Ménier, Dr. Stenhouse, and Mr. Church, and concludes with an eloquent peroration, which we should be glad to quote entire. One extract, however, must suffice, and we quote a paragraph which contains a valuable suggestion, and which shows the author's modest appreciation of his own work:—

"Possibly at some future Exhibition the machinery of Juries appointed for the award of individual honours may be altogether dispensed with, and replaced by the organisation of competent Commissions, charged to report upon the progress of the various arts and manufactures during a given period. The conception of such a unitary report has been floating in the mind of the reporter while collecting the materials for the preceding imperfect sketches. He would have been glad to compress into a single frame a complete picture of the chemico-industrial movement of the last ten years; so that this report might have remained the chemico-industrial history of a period distinguished by a series of brilliant successes affecting all the material interests of society. But the task has been beyond his powers. Unable to stretch over the immense tract which chemistry, like a mighty river, fertilises, he has been carried along the stream, exhausted by the length of its course, bewildered by the rapidity of its current, perplexed by the endless number of its ramifications."

"But incomplete," as the author says "it is," this report stands alone among those produced by the Exhibition. For breadth of view, for completeness of detail, and for loftiness of tone, it is unequalled; and, as it is, it may well stand as a model for all future reporters.

The Royal Society.—The following list of candidates have been recommended by the Council for election into the Society. The election will take place on Thursday, June 2, at 4 o'clock:—Sir Henry Barkly, K.C.B., William Brinton, M.D., T. Spencer Cobbold, M.D., Alexander John Ellis, Esq., John Evans, Esq., William Henry Flower, Esq., Thomas Grubb, Esq, Sir John Charles Dalrymple Hay, Bart., William Jenner, M.D., Sir Charles Locock, Bart., M.D., William Sanders, Esq., Col. William James Smythe, R.A., Lieut.-Col. Alexander Strange, Robert Warington, Esq., Nicholas Wood, Esq.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

870. Elijah Aldis, Arthur Grove, Kentish Town, London "An improved apparatus for burning magnesium wire for illuminating purposes."—Petition recorded April 7, 1864.

925. Frederick Albert Gatty, Accrington, Lancashire, "Improvements in treating garancine and other products of madder."—Petition recorded April 13, 1864.

952. Charles Doughty and William Drake Key, Lincoln, "Improvements in treating a product obtained in refining the oil of cotton seeds."

955. James Cane Coombe, Swinton Street, London, "Improvements in the preparation of fertilising agents for agricultural, horticultural, and other analogous purposes."—Petitions recorded April 15, 1864.

959. William Clark, Chancery Lane, London, "Improvements in the preservation of animal matters."—A communication from Jean Pierre Liès-Bodart, Boulevart St. Martin, Paris.

961. Walter Payton, Bedford Place, Commercial Road, London, "Improvements in apparatus for measuring water and other liquids."

964. John Riley, Hapton, near Accrington, Lancashire, "An improved sizing substance."

965. Alfred Vincent Newton, Chancery Lane, London, "An improved mode of manufacturing cerealine."—A communication from James Brown, Philadelphia, U.S.—Petitions recorded April 16, 1864.

974. George Davies, Serle Street, London, "An improved respiratory apparatus."—A communication from Albert Galibert, Paris.—Petition recorded April 18, 1864.

981. Hugo Levinstein, New Bridge Street, Blackfriars, "Improvements in the preparation of purple, violet, and blue aniline dyes."

990. Alexander Colvin Fraser, Loughborough, Leicestershire, "Improvements in apparatus used in the manufacture of gas."—Petitions recorded April 20, 1864.

1000. Henri Adrien Bonneville, Rue du Mont Thabor, Paris, France, "Improvements in photographic apparatus."—A communication from Doctor Desiré Charles Emmanuel van Monckhoven, Ghent, Belgium.—Petition recorded April 21, 1864.

1012. George Davies, Serle Street, London, "Improvements in inhaling apparatus."—A communication from Emile Siegle, Stuttgard, Wurtemburg.

1019. James Edward Duyck, Stamford Street, Blackfriars, Surrey, "Improvements in distilling and purifying petroleum oils and other hydrocarbons, and in apparatus employed therein."—Petition recorded April 22, 1864.

1060. Richard Archibald Brooman, Fleet Street, London, "Improvements in producing photographic pictures photogenically indelible."—A communication from Charles Raphael Maréchal, jun., and Cyprien Marie Tessié du Motay, Metz, France.

Notices to Proceed.

3207. George Haseltine, Southampton Buildings, Chancery Lane, London, "An improved oil, more especially designed for mixing paints and colours, and a new mode of manufacturing the same." A communication from Adolph Millochan, New York, U.S.—Petition recorded December 16, 1863.

3259. Nathaniel Lloyd and Edwin Hargraves, Church, near Accrington, Lancashire, "Improvements in treating printed and dyed fabrics."—Petition recorded December 24, 1863.

5. William Clark, Chancery Lane, London, "Improvements in the manufacture of chlorine." A communication from François Marie Aubert de Tregomain, Paris, France.—Petition recorded January 1, 1864.

363. Peter Armande le Comte de Fontainemoreau, South Street, Finsbury, London, "Improvements in photographic apparatus." A communication from Alphonse Liébert and Jean Lafon, Saint Cyr, Paris.—Petition recorded February 11, 1864.

728. François Louis Roux, Abingdon Street, Westminster, "An improved plastic compound for the protection of metallic and non-metallic surfaces from the action of water, air, and other causes of deterioration."—Petition recorded March 23, 1864.

CORRESPONDENCE.

Oxalate of Lime.

To the Editor of the Chemical News.

Sir,—Having seen in your Answers to Correspondents of last week that "A Student" has been asking what use he can make of the oxalate of lime, may I be permitted to remind him that carbonic ~~acid~~ oxide may be readily obtained by simply heating the dry oxalate in a flask fitted with a delivery tube? It is advisable to pass the evolved gas through a wash bottle containing a little solution of caustic alkali to absorb the small quantity of carbonic acid which usually comes over with the oxide. The residue left in the flask may afterwards be heated still more strongly, and then used in the preparation of lime-water, as you have suggested.—I am, &c.

John Newlands, F.C.S.

MISCELLANEOUS.

Poisoning by Digitaline.—A very important trial is now proceeding in Paris, in which a physician is accused of poisoning a lady by means of digitaline. All the French toxicologists of note will be examined in the case, and their evidence is looked for with much interest.

Young v. Fernie.—This great trial is now so far concluded that it only waits the judgment of the Vice-Chancellor. It occupied the Court eighteen entire days, and parts of sixteen others. Having now the whole of the evidence before us, we shall proceed to give a succinct *resumé* of the principal points in dispute.

The next Pharmacopœia.—At a meeting on April 27, the Medical Council appointed a committee to consider and report on the arrangements to be made for producing the next edition of the "British Pharmacopœia," and on the 29th the following report was received and adopted:—"1. That it is desirable to make further arrangements during the present Session of Council for preparing the next edition of the 'British Pharmacopœia.' 2. That a Committee of the Council be appointed to superintend the preparing for the press, and the editing of the work, and to submit the same to the Council for approval, in proof. 3. That the gentlemen already nominated in London, Edinburgh, and Dublin, for the purpose of reporting from time to time on the improvements in pharmacy, be requested to continue their services, and their report be communicated to the Pharmacopœia Committee of the Council. 4. That an editor or editors shall be appointed by the Pharmacopœia Committee, who shall prepare the work, in all its details, under their control."

The New Pharmacy Bill.—The following are the principal provisions of the bill proposed by the Council of the Pharmaceutical Society. The preamble, of course, recites that it is expedient for the safety of the public that such a bill should pass. Clause 1, then, enacts that after January 1, 1864, all chemists and druggists, not members of the Pharmaceutical Society, who compound prescriptions, shall be examined, unless, as after appears, they be already established in business. Clauses 2 and 3 relate to the appointments of examiners and registrar. Clause 4 permits the registration of chemists and druggists actually in business on payment of a fee not exceeding one guinea. Clause 5 allows the registration of assistants engaged as such before January 1, 1865, on payment of five shillings. Clause 6 allows such assistants and associates (before the above date) of the Pharmaceutical Society to become registered when commencing business on payment of one guinea. Clauses 7, 8, 9, 10, and 11 relate to the evidence required before registration, and the duties of the registrar. Clause 12 imposes a penalty for obtaining registration on false pretences, and Clause 13 imposes a penalty for falsely pretending to be registered. Clause 14 directs the fees payable under the Act to be paid to the treasurer of the Pharmaceutical Society. Clause 15 allows registered chemists and druggists *who have passed the minor examination* to vote at the meetings of the Pharmaceutical Society. Clause 16 legalises the application of the funds of the Benevolent Society to the relief of the newly-registered chemists and druggists, and their widows and orphans.

Gold Mining in Wales.—The most noteworthy fact in connection with British mining which has presented itself during the quarter, has been the production of gold from the quartz lodes of the Cambrian Hills. Many years have passed away since we were told that gold was to be found in Merionethshire. Some of the precious metal was exhibited in 1851, but this had been obtained at a cost which far exceeded its value. In 1861, the Vigra and Clogau mine gave 2784 standard ounces of gold to the adventurers, but in 1862 they obtained 5299 ounces. For some time the prospects were dull, and large quantities of quartz were worked containing no visible gold, and an infinitesimally small proportion was separated by amalgamation. However, the prospects brightened towards the close of the year 1863; and during the past quarter the following quantities have been duly reported:—

	Oz.	dwts.		Cwt.	qr.	s.	
1	103	11	from	7	1	23	of quartz.
2	185	16	,,	8	1	14	,,
3	296	16	,,	10	3	0	,,
	586	3		26	2	9	

This is, perhaps, the most extraordinary yield of gold from the vein on record. We find, however, by the report of the Vigra and Clogau Mining Company, that since the date of their last report 1059 ounces of gold have been received, this being obtained from quartz giving 24 ounces of gold to the ton.—*Chronicles of Mining, &c., in the "Quarterly Journal of Science."*

Artificial Production of Monsters.—A series of experiments have been made by M. Barthélemy on monstrosities, both artificial and natural, among the lepidoptera. He performed his experiments chiefly on the chrysalis, and endeavoured to cause modifications similar to those obtained by covering the eggs of birds with varnish. On covering the chrysalis with oil, it was found that they died before completing the metamorphoses; but on covering either the thoracic or abdominal part with wax, a retardation of development was perceived, but this was much greater with the thoracic parts. The cephalic part of the nervous system was much retarded in development, but the other parts of the ganglionic chain appeared to be developed as usual. He succeeded also in suppressing the development of the generative organs.

ANSWERS TO CORRESPONDENTS.

T. S. M.—Use strong glue.

A Subscriber.—It is impossible to say what the colouring matter is without analysing the substance.

S.—A list was given in a recent number of the Chemical News.

A Reader.—We report all which are accessible.

Kyonol.—1. Not that we know of. 2. It is precipitated from a salt by a caustic alkali.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Chloro- and Bromo-Metallic Ethers of Thallium, by M. J. Nickles.

Some years ago I showed that metallic chlorides and bromides capable of forming chloro- and bromo- salts' could, like simple acids, combine with ether to form definite compounds generally containing several equivalents of ether. The subsequent discovery of thallium has given me the opportunity of verifying this fact with the new metal.

We know in fact, that, among others, thallium forms with chlorine, a compound Cl_2Tl,[*] with which M. Wilm obtained double chloride $Cl_3Tl,3\,(ClNH_4)$. I find that this trichloride or chloro-thallic acid is able to unite with several equivalents of ether.

By passing a current of chlorine into ether standing over thallium, or, better still, over protochloride ClTl, the whole is gradually dissolved, and after a time the balloon contains simply a limpid liquid, free from all solid matter. By using a sufficient quantity of anhydrous ether, two layers will be found in the balloon; the lower one containing the new chloro-metallic ether[†] mixed with chlorated products, derived from substitution. In this state it fumes in the air, evolving hydrochloric acid gas; it then is very little soluble in ether and water, but is rendered soluble in them by the addition of hydrochloric acid. Alcohol dissolves it easily.

It is not volatile, but is destroyed by heat, leaving a residuum of chloride of thallium and carbon, and evolving hydrochloric acid. It is purified by heating in a water-bath in a current of dry carbonic acid. The gas disengaged takes with it large quantities of hydrochloric gas, and with the ether are condensed the substituted products so well studied by M. Malaguti.

The residue constitutes the compound sought for; in this state it is soluble in ether and water, assisted by a certain quantity of fixed hydrochloric acid. It is also very acid and effervesces with alkaline carbonates. An excess of these separates TlO_3 in a brown powder. Sulphurous acid also destroys this ether, producing protochloride ClTl.

Analytical results agree with the formula—

$$Cl_3Tl,2(C_4H_5O)ClH+2IHO.\ddagger$$

The water evidently has been carried off by ClH, which, it is well known, condenses aqueous vapour so energetically.

In aqueous solutions of alkaline chlorides this state is speedily changed; by evaporation the liquid gives well crystallised double chlorides.

Bromo-thallic ether, $Br_3Tl,3\,(C_4H_5O)$ usually partakes of the properties of the preceding ether. Thallium dissolves in bromine only after a considerable time; but in presence of ether the solution is quickly effected; the two layers are formed, the compound in question being in the lower one, which it renders fuming. It is not volatile; heated it gives a residue of bromides of thallium crystallised in yellow needles.

This ether is rapidly produced by mixing bromide of thallium, bromine, and ether. It dissolves in alkaline bromides, forming with them bromo-salts, such as—

$$Br_3Tl,BrNH_4+4HO,$$

crystallised in rhomboidal tablets;

$$Br_3Tl,BrNH_4+8HO,$$

crystallised in needles.

These two salts melt in their water of crystallisation below 100°; the fixed alkalines precipitate from it TlO_3; sulphurous acid separates thallium from it in the state of protochloride.[§]

Iodo-thallic ether, if it exists at all, is very unstable. By treating thallium by iodine and ether, a brown solution is obtained, which gradually abandons needles of I_3Tl, very soluble in ether, and containing iodine in excess. The same iodide is formed by digesting thallium, iodine, and an alkaline iodide with alcohol. A double iodide is then produced.

Iodo-thallate of ammonium occurs in the form of red rhomboidal tablets, seemingly isomorphous with the foregoing; heat does not melt them, but turns them black and then yellow, driving off not only their water, but also sufficient iodine to reduce I_3Tl to ITl.

I shall return to these combinations as well as to others which may be effected with fluorine,[‖] but for the present must confine myself to verifying with trichloride and tribromide of thallium the fact previously stated—namely, that metallic chlorides and bromides capable of acting as acids will unite with several equivalents of ether, like a polybasic acid.—*Comptes Rendus*, lviii. 537.

The Action of Oxide of Copper on an Alkaline Solution of Glucose, by M. E. Reichardt.

By adding to recently-precipitated oxide of copper an excess of potash or soda, and sufficient glucose to produce a limpid blue solution, reduction will be effected at the ordinary temperature; light and heat will accelerate the reaction. If the excess of alkali is inconsiderable, it will be quickly neutralised; the reduction is at this moment arrested. By the following operation the acid formed may be isolated:—

Dissolve a certain quantity of acetate of copper, supersaturate this salt by a slight excess of alkali, keeping the temperature at about 60°; add glucose until the oxide of copper is completely reduced. From time to time ascertain that the liquid remains alkaline; at the end of the operation filter. Neutralise the liquid by acetic acid, slightly exceeding saturation, then precipitate the new acid, gummic acid,[*] by acetate of lead or chloride of barium.

In this liquid thus precipitated, subacetate of lead again precipitates a gum.

Gummic acid is isolated by decomposing its salt of lead by sulphuretted hydrogen, or its salt of baryta by sulphuric acid. When sulphuretted hydrogen is used the acid seems more liable to alteration, and becomes brown by evaporation at 60°. It is better then to precipitate it in the state of salt of baryta, and to decompose this salt by a slight excess of sulphuric acid. The acid solution, evaporated with gentle heat, leaves the

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[*] Probably meant for $TlCl_3$.

[†] The combination is not effected directly, even at 100°, in a tube containing Cl_3Tl_2 with anhydrous ether.

[‡] We may take this opportunity of stating that the *Comptes-Rendus*, the official record of the proceedings of the Academy of Sciences, has for some time past been remarkable for the numerous blunders and misprints which occur in papers on chemical subjects. Many of these we are able to correct in the translation, but we are unable to assist our readers to the comprehension of 2IHO.—Ed. *C. N.*

[§] Protobromide we suppose is meant.

[‖] Such as FlHFlTl+2HO, by treating thallium with hydrofluoric acid, and FlTl by submitting this salt to the action of heat.

[*] This name has already been applied by M. Frémy to the soluble acid obtained by heating metagummic acid with a little potash.

acid in the form of rhomboidal prisms, with the strongly acid flavour of citric or tartaric acid.

The crystallised acid loses no water at 100°. It browns at 130°, melts and decomposes at 150°.

Analyses agree with the formula $C_6H_5O_{10}$, verified by the study of several salts.

Gummic acid is very soluble in water and alcohol. Perchloride of iron neither precipitates nor colours its solutions.

Chloride of calcium with the neutral salts yields a white flaky precipitate of gummate of lime, slightly soluble in an excess of acetic acid, soluble in an excess of chloride of calcium. The author gives it the formula—

$$2CaO,C_6H_5O_{10}+2HO+Aq.$$ [†]

The *baryta salt* resembles the lime salt. Heat easily decomposes it; even at 100° it disengages water with a feeble acid reaction, leaving carbonate of baryta as residue. It contains—

$$2BaO,C_6H_5O_{10}+HO.$$

Salts of lead and silver contain, one—

$$3PbO,C_6H_5O_{10}+3HO;$$

the other—

$$2AgO,C_6H_5O_{10}.$$

The latter ignites when heated to 135° or 150°.

Gum.—After the separation of the gummic acid by acetate of lead, a gummy substance, much resembling dextrine, is precipitated. This substance gives, with Trommer's reagent, a green precipitate, which remains unaltered by boiling. Sulphuric acid transforms it into a sugar, reducing the cupro-potassic liquid. Nitric acid oxidises it when hot, with production of oxalic acid.

The analysis of the sodic and barytic combinations of this gum give the formula—$C_{12}H_{13}O_{13}$.—*Bulletin de la Société Chimique*, iii., 197.

Decomposition of Water by Phosphorus, Arsenic, and Antimony, under the Influence of Nitric Acid, with Production of Ammonia, by M. Personne.

The solution of phosphorus in nitric acid, concentrated or diluted with one or two volumes of water, is, as is well known, effected with disengagement of nitrous vapour, abundant if the acid is concentrated, and diminishing in proportion as it is more diluted. In any case if, when the solution is effected, excess of potash is added to the hot solution, sufficient ammonia is disengaged to become evident, both by reagents and by its odour. Whether normal or amorphous phosphorus is used in this operation, the phenomena and the products are identical.

It was interesting to ascertain whether the fact of the production of ammonia was observable with the bodies forming part of the phosphorus group, as arsenic and antimony.

I operated with distilled arsenic and with antimony purified three times by fusion with nitre.

These two bodies pulverised and heated were attacked by nitric acid, diluted with its volume of water. Under these circumstances arsenic is easily attacked, giving arsenious acid and a little arsenic acid; antimony, on the contrary, is attacked with more difficulty. However that may be, if ammonia is looked for in the liquids obtained it will be found that these two bodies have behaved like phosphorus, with this difference, that phosphorus gives more ammonia than does arsenic, and arsenic more than antimony.

The phenomenon of the formation of ammonia by the decomposition of water under the influence of nitric acid has hitherto been observed only with metals of the third and fourth section, as iron, zinc, tin, &c.

The above observations show that this phenomenon is not limited to these metals, but belongs equally to the metalloids of the phosphorus group. — *Bulletin de la Société Chemique*, vi. 163.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by George F. Rodwell, *F.C.S.*

(*Continued from page* 52.)

6. **Thomas Hobbes.**—On the discovery of the Torricellian vacuum, philosophers became divided into two sects, called respectively "Vacuists" and "Plenists," the former maintaining that a vacuum was possible and capable of being obtained by certain physical processes, the latter that the world was everywhere full, and the production of a vacuum impossible. Among the Vacuists were Otto von Guericke, Pascal, Boyle, and the greater number of the experimental philosophers who were in the habit of meeting at Gresham College for the discussion of scientific matters; and among the Plenists were Mersennus, Noel, Thomas Hobbes, Franciscus Linus, and the Cartesians:—of these latter Boyle writes, "the subtilest and wariest champions for a plenum I have yet met with."

We have previously [*] spoken of Noel and Mersennus, and we have now to consider the opinions of Thomas Hobbes.[†]

Of the theological and mathematical writings of Hobbes I can have nothing to say here, but I consider that the views put forward in his philosophical treatises, in so far as they relate to the air, are far less advanced than those of his contemporaries—less advanced, indeed, than those of many of the ancient philosophers who preceded him by nearly twenty centuries. Although intimately acquainted with Bacon and Galileo, the fathers of experimental philosophy, he was himself no experimental philosopher, but he preferred to prove his assertions by reasoning, rather than by well-founded observation and experiment. He deprecated the trying of experiments, and was specially bitter against the recently-formed Society of Experimental Philosophers, the object of which was to do away with the baseless structure of the old speculative philosophy and to found a new philosophy resting on a solid experimental basis.

The language which Hobbes employs in controversy abounds with vituperation, and is in every way utterly unbecoming a philosopher. His arguments are frequently puerile and without weight, and the objections which he urges in order to prove the fallacy of a theory or experiment are often paltry and trifling. In the following words [‡] he addresses Dr. Ward and Dr. Wallis, who had opposed some of his views:—"But I here dismiss you both together. So go your ways, you uncivil Ecclesiastics, inhumane Divines, Dedoctors of morality, unasinous Colleagues, egregious pair of Issachars, most

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[†] We can hardly understand how this formula can agree with that given for the acid $C_6H_5O_{10}$. The latter is, however, itself improbable on account of the imperfect number of hydrogen atoms it contains.—C. F.

[*] See the third of these papers, Chem. News, vol. viii., p. 246.

[†] Born 1588. Died 1679.

[‡] See "Lessons on the Principles of Geometry, to the Egregious Professors of the Mathematics, one of Geometry the other of Astronomy, in the Chairs set up by the noble and learned Sir Henry Savile in the University of Oxford." Lesson vi., "On Manners."

wretched Vindices[§] and Indices Academiarum, and remember Vespasian's law,[‖] that it is uncivil to give ill language first, but civil and lawful to return it."

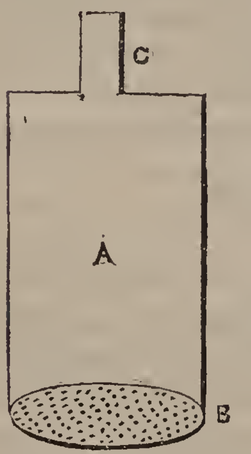
Hobbes himself did not always remember the first sentence of the law, but assuredly he never forgot the last; it is right to add, however, that the learned Savilian professors were by no means so tolerant in the controversy as they might have been, and although they did not make use of such contumelious epithets as Hobbes employs, they occasionally made rather offensive puns on his name:—it is curious, in a treatise devoted to the explanation of some problem in the higher mathematics, to find such words as "*hob*-goblin."

Hobbes did not turn his attention to natural philosophy till somewhat late in life; his adoption of the views of the Plenists may probably be accounted for by the fact that he was well acquainted with Mersennus and Des Cartes, two of the most notorious of the Plenists. In some of his physical views he was almost a Cartesian.

Hobbes did not admit the condensation or rarefaction of matter; he believed the whole world to be full, and that it could not be fuller than full or less full than full.

He conceived that the air consists of an ethereal substance extending as far as the sun, in which ether, myriads of hard atoms possessing simple circular motion of their own, move; these atoms exist in greater quantity near the surface of the earth than at some distance above it. He denied that the air possesses either weight or elasticity. "Utraque illa phantasia," he writes, "tum gravitatis atmosphæræ, tum vis elasticæ sive antitupiæ[¶] aëris, somnium erat."

Hobbes adduces a very simple experiment to prove the universality of a Plenum, an experiment for the production of which there was required neither expensive apparatus nor careful manipulation, for the sole apparatus was a gardener's watering pot, and the experiment was made whenever it was used. The watering pot, which was in use 200 years ago, consisted of a circular vessel A, the bottom of which, B, was pierced with a number of minute holes; it was terminated above by an opening, C, capable of being closed by the finger. Water would obviously be retained in such a vessel by the pressure of the air as long as C remained closed, but directly it was opened water would flow from the bottom of the vessel. That no water flows from A until C is opened is according to Hobbes positive proof of a plenum, for, he reasons, as the world is full, there is no place for the water to go into until C is unstopped, when the air, which is displaced by the descending water, enters and takes the place of the water which flows from the vessel. "And this," he writes, "I take for a sign that all space is full; for without this the natural motion of the water, which is a heavy body downwards, would not be hindered."[**]



As Hobbes was a plenist, he of course contended that Boyle's air-pump did not produce a vacuum. He speaks of it as being "of the nature of a pop-gun which children use, but great, costly, and more ingenious," and he maintains that the effects produced by it are such as would be produced by a strong wind cooped up in a narrow room. In the first place, when the piston is drawn from one end of the cylinder to the other, he affirms that no air is removed, but sufficient "pure air" to fill the space deserted by the piston enters between it and the surface of the cylinder; for, although the piston was closely fitted into the cylinder with well-oiled leather, it may, he says, keep out "straws and feathers," but not air, "for the body of leather will give passage both to air and water, as you will confess when you ride in rainy and windy weather." (It was by trifling arguments of this sort that Hobbes sought to confute results obtained by one of the most careful and persevering experimenters of the day.) The pure air which forcibly enters between the piston and the surface of the cylinder generates a most violent motion of the air within the air-pump receiver, and this violently-agitated air produces all the effects observed in the receiver after long-continued pumping.

Animals suffer death in the receiver because the rapid motion of the air stops the passage of their blood, but here Hobbes' argument is greatly at fault, for he states elsewhere that the air supports life, because when we breathe we draw in a great number of the swiftly-moving atoms in the air, which pass into the blood, and by their motion cause it to circulate through the veins and arteries; if this be the case, and the above theory obtains, animals ought obviously to have a quicker circulation of blood in the receiver; thus one theory destroys the other, and one is nullified before it leaves the hands of its propounder.

Boyle[††] has very ably answered all the objections which Hobbes raises against his "Physico-Mechanical Experiments," and the instruments which he employed for their production, and although first attacked, and somewhat violently too, he carries on the controversy in a far more tolerant spirit than that exhibited by his adversary.

As in the air-pump Hobbes admitted no rarefaction of the air, so in the air-gun[‡‡] he admitted no condensation. By working the piston, he contends, large numbers of the hard atoms in the air are forced into the gun, while the pure air escapes between the surfaces of the piston and the syringe; the motion of the injected hard particles becomes greater and greater with every stroke of the piston, and finally when the valve is opened the particles rush out violently, and carry with them a bullet or anything else in their path.

Hobbes, in common with the Plenists, did not allow that the space above the mercury in the Torricellian experiment is a vacuum; his explanation of the suspension of the mercury in the tube is very difficult to understand; he seems to have thought that the weight of the mercury column presses a certain amount of air into the upper

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[§] Ward had written a work entitled "Vindiciæ Academiarum."

[‖] Hobbes alludes to the following saying attributed to Vespasian, "Maledici senatoribus non oportere; remaledicere fas et civile esse."

[¶] From αντιτυπτω, to repel a blow, to react; a scarcely appropriate term to apply to an elastic body; inasmuch as elasticity signifies that property possessed by the atoms of certain bodies, in virtue of which when their relative position is altered by the addition of force, or the removal of force previously acting, they return to the position which they occupied prior to the addition or subtraction of that force.

[**] See "The English Works of Thomas Hobbes, of Malmesbury, now first collected and edited by Sir William Molesworth." Eleven vols. 1839-1845.

[††] See "An Examen of Mr. T. Hobbes, his Dialogus Physicus de Naturâ Aëris. As far as it concerns Mr. R. Boyle's book of new experiments touching the spring of the Air, &c. By the Author of those Experiments." London. 1662. Also, "Animadversions upon Mr. Hobbes' Problemata de Vacuo." By the Hon. Robert Boyle, Fellow of the Royal Society. London. 1674.

[‡‡] The air-gun was invented by M. Marin Bourgeois in 1607. The first account of it is given in a work entitled "Les Elemens de l'Artillerie: concernans tant la theorie que la pratique du Canon. Augmentés en cette nouvelle edition et enrichis de l'invention, description, et demonstration d'úne nouvelle artillerie que ne se charge que d'air ou d'eau pure, et a neanmoins une incroiable force, &c. Le tout par le sieur de Flurance Rivaul. Paris, 1608." There is a good copy of this curious work in the British Museum Library.

part of the tube, and that the column comes to rest when the weight of the mercury is "equal to the force which is required in air to go through it."

It had long been known that nitre when thrown on red hot coals engenders very rapid combustion; Hobbes explains this by supposing that nitre consists of "many orbs of salt filled with air," which air rushing violently from the nitre meets particles issuing from the burning coal in an opposite direction, and the two contrary motions produce the intense inflammation observed.

Hobbes was well aware that in many coal mines there exists a kind of matter which suffocates living creatures, and extinguishes flame; he speaks of it as "a certain matter of a middle nature between water and air," and as being perfectly transparent and not much lighter than water; elsewhere he speaks of the deadly fumes given off by burning charcoal, as consisting of a "flameless glowing fire, which dissipates those atoms that maintain the circulation of the blood." I do not find, however, that he traces any connexion between the suffocating gas of coal mines and the suffocating gas of burning charcoal.

Hobbes believed winds to be produced by clouds which descend by their own weight, and strike down the air beneath them; when the dejected masses of air reach the earth they rebound, and thus lateral winds moving in all directions are generated. Thunder and lightning are caused by air enclosed in hollow frozen clouds, which air being more and more pressed, at length the ethereal part of it passes out of the cloud, but a great number of hard particles endued with violent motion remain, and ultimately exert such force that the ice is suddenly broken, and the noise produced by the disruption is thunder.

The learned Editor of Hobbes' works speaks of him as "one of the greatest and most original thinkers in the English language." We speak here solely of his merits as a physical philosopher, and I think it will be admitted that he was neither a great physicist nor a man calculated to forward the interests of the then young experimental philosophy. But was it to be expected that the old speculative philosophy would be overthrown at the first onset? was it to be expected that its disciples would see their fabric destroyed without one blow in its defence? a radical change is never made without opposition, never established without a struggle, and the more violent that struggle the more surely and completely will the change be effected. Hobbes was a follower of the old philosophy, now about to be expelled from the human mind: he lived at the period of the change: should he not rise in the defence of that for which he had devoted his best energies? should he not make an effort to stem that tide which was so rapidly gaining ground?

Men like Hobbes (and we find many such in the history of Science), who rather than allow the falsity of an old and favourite theory, frame a more false theory to support it, even such men indirectly benefit Experimental Philosophy, for by propounding a fallacious theory, they cause experiments to be made for its refutation; and no experiment is made in vain, each one is another stone added to the great and rapidly-increasing structure of our Philosophy.

(To be continued.)

Process for Estimating the Value of Milk.—Take a known weight of the milk, heat it to boiling, then put it in a bottle, and allow it to cool to 12° or 15° (R.). Then shake the bottle until the butter separates, which can be removed, drained, and weighed. This simple operation twice repeated will give satisfactory results.—*Hozerman, Archiv. der Pharm.*, November, 1863

TECHNICAL CHEMISTRY.

Dulos' Processes of Engraving.

A copper plate, on which the design has been traced with lithographic ink, receives, by the action of the pile, a deposit of iron on the parts untouched by the ink; the ink having been removed by means of benzine, the white portions of the design are represented by the layer of iron, and the black by the copper itself; the plate is then plunged into a bath of cyanide of silver, under a galvanic current, and the silver is deposited on the copper only. In this condition mercury is poured over the plate, which attaches itself to the silvered portions only, appearing in relief, and taking the place of the lithographic ink. Then take, in plaster or melted wax, an imprint, the cast of which presenting the counterpart of the projections of mercury, gives a kind of copper plate engraving. This cast has not sufficient strength to bear the press; but by metallising the mould, and depositing upon it, electro-chemically, a layer of copper, we obtain an exact reproduction of the original projections of mercury, and in some sort a matrix by means of which impressions of the plate may be produced *ad infinitum*.

For typographic engraving (figures in relief), the plate of copper should receive, on leaving the hands of the designer, a layer of silver, deposited only on the parts untouched by the lithographic ink; the ink is removed by benzine, the surfaces first covered by the design are oxidised, and the treatment above described is continued. At the end of the operation the raised portions of the electro-chemical plate intended for the impression will be found to correspond with the tracing of the design, and the hollow portions with the thickenings raised about the design by the mercury.

This process, which is the starting-point and the basis of M. Dulos' invention, has led him to the discovery of some more simple methods, which have led to important practical results, the fusible metal or amalgam of copper substituted for mercury giving rapid and remarkably perfect results.—*Moniteur Scientifique*, vi. 215.

PHYSICAL SCIENCE.

Electro-Magnetic Induction Machines for Telegraphy.

A new induction machine is now to be seen in operation which produces a constant stream of electricity, and can be made to produce it of any tension or quantity that may be required. These are valuable properties, which doubtless will be appreciated by all those who are obliged to use galvanic batteries of high tension. Many attempts have been made to use induced electricity for telegraphy, but as these attempts have been generally made with machines similar to Rhumkorf's induction coil, they have failed, for the following reasons:—The electricity is in impulses, and alternately in reverse directions. It is in too small quantity, and too great tension; so much so, that it is said that Mr. Whitehouse's five-feet coil destroyed the Atlantic cable; but the authorities are not agreed on the point. However, it is certain that such machines are not suitable for telegraphy generally, even if one impulse be thrown out, so that all the impulses which are taken may in the same direction; for there is then no approach to a battery current. This has been done, but in all cases the most suitable impulse has been rejected, namely, the slow one, or making impulse, and the breaking impulse taken, which is of greater tension but shorter duration; of course, the absolute quantity of force in each is the same, and it will be clear that the former, approaching more nearly to a current, would be most suitable. In some cases the two reverse impulses are used; but these can only be used with one telegraphing arrangement, and that a slow one.

What has been wanted, and which is now obtained, is as near an approach to a battery current as may be, and of any tension required, without multiplying the number of battery cells used. Any machine to be of real use must not only possess these properties, but must be perfectly self-acting. The machine here spoken of possesses all these properties. Its current is perfectly continuous for all practical purposes, for no intermittance can be detected. It holds the needle perfectly steady, rings an electro-magnetic bell, produces electrolysis, and comports itself in every other way like a battery current, even producing no spark unless the poles be brought into absolute contact. The electricity which is used to excite the electro-magnets in the coils is at the same time made use of as magnetism in the electro-magnets to drive the battery break and commutator; so that the motive power, which makes this machine self-acting, is obtained without cost, because to produce induction the magnets in the coils must necessarily be excited, whether the magnetism so induced be otherwise used or not.

Two series of induction coils are used in this machine, which are so arranged that one series is being magnetised nearly at the same time that the magnetism is subsiding in the other, so that the two consequent induced impulses as it were overlap each other; and though these induced impulses are in opposite directions, the spools are so arranged that in the general induction circuit they flow in the same direction, thus making a compound impulse of longer duration composed of the two opposite inductions, and so blending the more intense with the less, the result being a sort of undulation of force. These compound impulses flow in opposite directions, and to make them a continuous flow they are taken up by a commutator which reverses its contacts as they reverse, and thus turns them all in one direction, producing a slightly-undulating but continuous flow. This seems to be the form of motion that all known forces take. The machine appears to be made for quantity, the inner coils being of No. 12 wire, and the outer of No. 18. Some electricians who have examined it, have expressed a fear that it might injure the insulation of gutta-perchaed wire, as this fault has been attributed to ordinary induction coils. Of course, this objection does not apply to this machine any more than to an ordinary battery; for to whatever purpose it may be applied its tension and quantity will be adjusted to the tension and quantity of the number of battery cells ordinarily required to perform that work; nevertheless, the machine is being subjected to continuous tests to put the thing beyond doubt. A gutta-perchaed wire is punctured and then immersed in water, and the leakage tested, then the full current sent through it for hours, but as yet no perceptible variation has been noticed.

Will it Answer?—Dr. Grusselbakc, Professor of Chemistry at the University of Upsala, is said to have restored to activity a snake which had been frozen torpid for ten years. He is also said to have proposed to the Swedish Government to make an experiment on a criminal condemned to death. He proposes to reduce the individual to complete torpor by the gradual application of cold, and to restore him to consciousness after having lain in that condition for a year or two, by sprinkling him with some stimulating wash the professor has invented.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture X.—*Saturday, January 23, 1864.*

Ladies and Gentlemen,—We will begin by considering more at length the localities in which diamond has been found. In India it is always found in the same kind of matrix — a breccia of red and yellow jasper, quartz, chalcedony, and hornstone, cemented by siliceous matter. This breccia is overlaid by a compact sandstone, and passes into a conglomerate of rounded pebbles or pudding-stone, the particles of which are united by a calcareo-argillaceous cement. The pebbles are easily disaggregated. In this conglomerate diamonds are generally met with. They are found near Cuddapah, on the Pennar river, in a stratum of about two or two feet and a-half in thickness. In this case also its matrix is a conglomerate, in which the pebbles are sometimes very large—as large as the head, and contain hornstone identical with that occurring in the neighbouring mountains. Diamond is found in exactly the same kind of matrix at Banganapilly, Madras, between the rivers Pennar and Krishna. The Golconda Mines were celebrated in former times, but are now almost, if not quite, deserted. It is reported by Tavernia that in 1660 60,000 persons were employed in the diamond mines there. The bed in which the diamonds are found rests on, and is surrounded by, granite. At Sambulpore, north of the Godavery River, is a bed in which they occur, consisting of the *débris* of the adjacent mountains washed down and deposited by river action. This bed is of ferruginous clay, containing siliceous pebbles, which appear to be derived from the rock originally enclosing the diamonds. It is found also at Bundelcund on a bed of granite overlaid with sandstone, on which is the same kind of breccia, and in this the diamonds are found. The granite here is partially covered with trap, and there no diamonds are met with. More southward the conglomerate is covered by limestone, which is believed by Franklin to be liassic. The sandstone is considered by him to be new red, but I am not quite sure whether that has been established. The sandstone is stated much to resemble the itacolumite of Brazil.

Diamonds are found in Borneo in a conglomerate of pebbles, diorite, and quartz, along with marl containing marine shells. Diamonds are there associated with magnetite—that is, magnetic oxide of iron—gold, platinum, and other things. They are also associated with a black quartz enclosing iron pyrites and occasionally also particles of platinum. This black stone is considered to be specially indicative of the occurrence of diamonds. They have been found also in Sumatra, and from Australia a single diamond was brought over some years ago by Sir Thomas Mitchell.

With reference to the occurrence of diamonds in Brazil, I may refer you for the details of the subject to the admirable essay of MM. Heusser and Claraz, a French translation of which is contained in the *Annales des Mines* for 1860 (volume 18). The locality and the mode of occurrence of diamond in Brazil have been very critically investigated.

We will now consider the character of the chief rocks constituting the diamond district.

First of all, there is quartzite, a siliceous rock, to which the name of itacolumite has been given, from Itacolumi, the name of a town. This rock is described as a granular, friable, quartzose sandstone, smaller or larger in grain, and it often contains talc, chlorite, and mica. On a large scale it always presents a more or less distinct slatey or schistose structure, showing clearly, or, at all events, indicating very strongly, its sedimentary origin. It is sometimes traversed by pyrophyllite, a beautiful talcose mineral like that occurring in the Ural. This quartzite in some places is found to be flexible. That is owing to the interposition of little micaceous scales. If we suppose that during the formation of a rock of this kind, particles of sand intermingled with mica constantly settling and going down with various degrees of rapidity—the particles of sand, perhaps, first constituting a small bed, which is then overlaid with little laminæ of mica, and then another bed of sand being deposited, and then laminæ of mica—we may get an idea of how this flexible rock has been formed. The flexibility is due to these little interposing laminæ of mica. Itacolumite is stated by geologists to be, beyond a doubt, a metamorphic rock—that is, a rock which has been changed materially subsequent to its deposition. It is said also to have been originally sedimentary. No fossils have been found in it. It is stated to resemble much the schistose quartzite near Breslau.

So much, then, for this quartzite, or itacolumite.

There is also a so-called metamorphic schist, which is very interesting in many respects. It is very variable in its characters, and contains quartz, sometimes associated with chlorite or talc, and sometimes with mica. In some localities it passes into a pure mica schist. As I said on the last occasion, no hornblende occurs in the varieties of this schist worked for diamonds. It generally forms elevated plains, and is easily weathered. It frequently passes insensibly into an argillaceous schist containing talc, mica, and disthene or cyanite, and also into itacolumite itself. In one locality fragments of crystalline schist form a conglomerate in the itacolumite. Limestone, and schistose red iron ore, and itabirite, as it is called, occur in the metamorphic schist. Itabirite is only a variety of the schistose red iron ore accompanied with quartz and mica. It sometimes forms thick beds of great extent, and when pulverulent it forms what is called jacotinga. The Gongo Soco mine is in such a bed. We have in the museum a very interesting case of diamonds with the associated minerals, to which I may refer you. The limestone also occurs in thick beds, in which are numerous caverns abounding with bones and saltpetre. The itacolumite and metamorphic schist generally occur inalternate beds.

As I said, the metamorphic schist is very easily disintegrated, sometimes being weathered, or decomposed, or softened to a great depth. It is said that the softening is due to the heavy tropical rains, reported to contain nitric acid after storms. In the products of the disintegration of the metamorphic schist and the itacolumite, as well as in the recent foundations derived from them, numerous rare minerals are found; and that is a very interesting point of our inquiry. First, we have the diamond: then that beautiful mineral, extremely rare and highly prized—the euclase; and also topaz, chrysolite, cymophane, transparent andalusite, tourmaline, amethyst, a beautiful variety of anatase and rutile.

Diamonds are met with in three distinct regions. First, they are met with in what is called gurgulho, which is derived from the itacolumite, and consists of a pure quartzose sand. This is washed, and with the diamond is obtained a residue of rutile, anatase, and magnetite. These more or less constantly accompany the diamond, and are regarded as an indication of its presence. As the minerals associated with the diamond are also found in itacolumite, it might be concluded with tolerable certainty that the diamond is derived from that rock. Moreover, the diamond occurs in most rivers rising in the midst of the itacolumite. This, then, was strong evidence; but we are now certain of the fact, because diamonds have been actually obtained by blasting an enormous rock of itacolumite, stamping and washing the fragments. One observer has seen four diamonds in the itacolumite in one spot. There is another variety of this gurgulho, formed from the metamorphic schist, in which the products are more or less mixed with those of itacolumite. As long as the superficial gurgulho yielded diamonds the exploration of the subjacent soft schist was never thought of; but in 1850, by chance, some of the schist was washed, and produced many diamonds. Ever since the schist which is derived from the metamorphic schist has been worked. No diamonds have yet been discovered in the metamorphic schist itself, but as yet it has not been properly *exploited*,—to use the French term. They, no doubt, are there, because we clearly find them in what are certainly the products of the weathering action of that schist. Observation has shown that the metamorphic schists—the richest in diamonds—are all of a grey or blackish colour, and are strongly impregnated with oxide of iron.

Then we find the diamond in the beds or on the banks of rivers, and these diamond workings are very extensive, and by far the most frequent. Generally the river beds are on the solid rock. This is covered with *dêbris* washed down from the adjacent mountains, forming the river bed, properly so-called. The material which forms this bed is called cascalho. This is the *dêbris* of the adjacent mountains which constitutes the river bed, and in this bed diamonds are frequently found. It is often covered with great blocks of itacolumite; and when hydrated sesquioxide of iron occurs in the vicinity it has cemented together the upper layers of this bed, and changed them into a conglomerate, which is sometimes so hard as to require blasting. This conglomerate not unfrequently contains diamonds. In the cascalho we find the united products of the weathering both of itacolumite and metamorphic schist. There is, therefore, no doubt whatever of the derivation of the diamond from the itacolumite and the schist, though it by no means follows that they should be uniformly found in these rocks. In the Brazilian cascalho, Damour has mentioned the occurrence of disthene, felspar, almandine, hydrophosphate of alumina, titaniferous phosphate of yttria—a very rare substance—diaspore, and tantalite, baierine [columite], oxide of tin, cinnabar, and, which is interesting—graphite—another variety of carbon. Gold is diffused in the Brazilian diamond-bearing schists, and also platinum. The association of gold with diamond is a very interesting fact.

In the Ural diamonds have been found since Humboldt's visit in 1829. He suggested the probable existence of diamonds there, from the geological similarity of the district to that of Brazil. The mountains are described as itacolumite passing into clay slate, talcose schist, and dolomite. The diamonds are found in a stream work a foot and a-half or two feet thick. Below is a bed of disintegrated dolomite, from two to five feet thick. In this, however, no diamonds have as yet been detected. The dolomite contains crystals of quartz and many fossils. The diamonds are associated with brown iron ore, specular iron ore, magnetite, anatase, and gold. A few diamonds have been found in a rock similar in all respects, apparently, to itacolumite, occurring in North Carolina and Georgia. It is a laminated, granular quartz. The lamination is said to be owing to the intermixture of a little mica. The diamonds occur in a river bed similar to that of Brazil.

I need not say more concerning the mode of the occurrence of diamonds. Now comes the question—and it is a question which has not yet received solution—if this itacolumite be, as there is no doubt it is, a rock of sedimentary origin, have the diamonds been developed in this rock subsequent to its deposition, or derived from the preexisting rock, out of which this secondary rock has been made? With regard to the possibility of making diamonds, scarcely a chemist is to be found who doubts that one day or other diamonds will be made. Numerous attempts have been made from time to time to produce them artificially, and the experiments have extended over several years; I recollect trying one myself for ten years, but the attempt proved abortive. One gentleman, especially, has devoted a great deal of attention to this subject, and he maintains most positively that he succeeding in producing a diamond; I asked him where the diamond was, but he stated that unfortunately during one of his investigations the diamond slipped out of his hand, and could nowhere be found, and he has not been able to produce another. Various experiments have been made upon bisulphide of carbon. We were informed a good many years ago that some French chemist had succeeded in making a diamond by plunging phosphorus into this liquid compound of sulphur and carbon, which has a high refractive power. It was said that in this way the diamond might be produced, the sulphur being taken away from the compound by the phosphorus and the carbon being set free in a crystalline form. Then, again, it has been attempted to decompose the bisulphide of carbon by means of silver; I kept a piece of silver in that liquid for ten or twelve years. The silver became blackened on the surface, which seemed to be an indication of decomposition, as though the sulphur were taken away so as to allow the gradual elimination of the carbon. Unfortunately it happened that this bisulphide of carbon operated upon had not been perfectly free from sulphur, and all that the silver did was to take out the sulphur which had been contained in that state of solution in the bisulphide.

I am sorry that I am not able to present to you a a definite account of the mode of making diamonds, affording you some clue to their formation. At present, candour compels us to say that we have no clue whatever, as far as I know, to the mode in which diamonds have been produced in nature; most certain it is that a high temperature has not been employed, because it loses its character at a high temperature. There are many unstable compounds of carbon now known, and which possibly may be produced one day by electrolytic action, and then we may hope to be able to generate this precious mineral—the diamond.

The next subject which I have to bring to your notice is one of great interest—namely, graphite, black lead, or plumbago. It occurs abundantly in nature, and is devoted, as you all know, to manifold uses. It is nothing more than a crystallised variety of carbon, but the system of crystallisation differs from that in which the diamond crystallises. Graphite is rhombohedral, and diamond is cubical.

The chemical properties of graphite have been carefully investigated of late by Professor Brodie, of Oxford. He has obtained some curious results, which are worthy of attentive study. Graphite occurs as a dark grey substance, having a more or less metallic lustre. It is soft, and may generally be scratched by the finger-nail. It produces the well-known mark of "black lead." It is perfectly infusible at the highest possible temperatures, and perfectly fixed, so far as we know. You may heat it as strongly as you like, applying the highest temperature possible, and yet not a particle of it shall be volatilised. It burns with great difficulty, requiring exposure to a high temperature for a long time, and on this account it is used with great success for making crucibles. You may take a graphite crucible, heat it for four or five hours in a white hot furnace, and yet it shall only burn very partially away. Of course some of the substance will disappear, but it will stand exposure for a very long time to a high temperature with access of air.

With regard to the mode of formation of graphite, we can produce it artificially, and sometimes obtain it beautifully crystallised. It is an accidental product of our iron furnaces. It frequently occurs there, and is known under the name of "kish." It exists in all grey pig iron. There is, indeed, reason to believe that grey pig iron—at least, if it could be got in a state of purity consisting only of carbon and iron, though I am afraid we do not get it in that state—would, in the solid state, be nothing more than malleable or wrought iron with carbon diffused through it, and that there is no combination, or scarcely any, at all events. There is a specimen taken from the bear, as it is termed—that is, a ferruginous mass occurring at the bottom of our iron furnaces. Here, again, I have another specimen—pounds of it altogether, taken from a blast furnace. Sometimes we obtain it, as I have said, very distinctly crystallised. When we bring malleable iron—that is, wrought iron—into contact with carbon—any kind of carbon—common wood charcoal, to wit—at a high temperature, they do combine undoubtedly. The carbon is taken up and dissolved by the iron, forming the various kinds of pig iron; but on cooling that carbon separates in a great measure, certainly, under ordinary conditions, in the state of graphite. That we can prove. We see the graphitic appearance of the fracture of pig iron. Then, by the action of acids, we can dissolve out the iron and obtain the graphite scales. I think that the solubility of this graphite in iron varies to a certain extent with the temperature. We can make iron take up very much more graphite at a high temperature than it can retain at a low temperature; therefore, you can understand how we can produce graphite in this way with the greatest ease. We have a variety of graphitic carbon which is generated in our covered gas-retorts. Everybody knows that in course of time these gas-retorts become covered with a firmly adherent deposit of difficultly combustible carbonaceous matter similar to graphite. In this case the carbon is separated by the action of a high temperature upon a hydrocarbon—some hydrocarbon developed during the production of the gas by the distillation of the coal. That is a common case. The carbon is always deposited in the graphitic state, having a high lustre. We may make graphite directly by the action of chloride of carbon upon molten pig iron.

I will throw out one suggestion on the formation of diamond again while upon this subject, before I proceed to consider the mode of the occurrence of graphite in nature. You will remember that when speaking of aluminium and silicon, I said that aluminium had the property of dissolving silicon, and that the silicon separated during solidification, and was obtained in the octahedral state. I said also that zinc has that property of dissolving silicon, and that aluminium has the property likewise of dissolving silicon. In the case of the aluminium, the silicon separates in the octahedral form; and in the case of the zinc the silicon separates in another crystalline state—the rhombohedral form. We have, then, two distinct kinds of crystals of silicon—the one produced from solution (if I may use the expression) in zinc; the other produced from solution in aluminium. Professor Wöhler has been working with the subject of calcium. He finds that that metal has the property of combining with carbon to a great extent. I do not know the exact conditions of these experiments, but if the combination should take place at a low temperature, it is just possible that we may get a similar action to what occurs in the case of silicon, and possibly the fused carbon might separate out of this calcium in another crystalline state. That is, of course, conjectural.

Graphite occurs in nature in granite, gneiss, mica-slate, and crystalline limestone. The crystals in the limestone are sometimes in the form of delicate plates, and I cannot understand how they could have got there; but there is the fact, and we must leave it as a problem yet to be solved. Graphite occurs also in greenstone, and in nests; in trap at Borrowdale, in Cumberland, and also at Arendal, in Norway, in quartz. I might also mention other places. I have here on the table a series of graphite, and a very interesting series it is. You can examine it hereafter.

The next variety of carbon need only be mentioned. It is the amorphous state of carbon, which is well represented to us by ordinary charcoal. It is perfectly noncrystalline. You see what a parallel series we have between carbon and silicon. There are two states of crystallisation in which silicon occurs, and then we have the amorphous condition. Here in the case of carbon we have two crystalline states—diamond and graphite, and the amorphous condition. It is not my business here to describe carbon. It is entirely a chemical question, and has no interest except from a chemical point of view.

We have to consider to-day the various of mineral fuel, or carbonaceous deposit, as I term them—certain kinds of coal, and certain other accessory carbonaceous matters. It is perfectly clear that all these carbonaceous matters have been derived originally from woody tissue. I shall not stay to attempt to establish that proposition. I must take it for granted. The evidence to be found in any geological book or any chemical book is so clear as to leave no doubt upon that point.

We must say a few words about wood. Wood consists essentially of carbon, hydrogen, oxygen, and nitrogen, together with what is termed inorganic or mineral matter—earthy matter. If we take a piece of charcoal and burn it away in the air, there will remain a white ash. That white ash is the mineral matter to which I allude. It consists of various so-called mineral ingredients. From the analyses of an extensive series of woods from various kinds of trees, and of different parts of those trees at different ages, I have deduced this as the average composition of wood:—

Carbon	51·22
Hydrogen	6·24
Oxygen	41·45
Nitrogen	1·10
Ash	1·77

This is information which we require in the consideration of the formation of coal, as you will see presently. There is always nitrogen in wood, though it was formerly supposed to be absent. I do not think I need trouble you much on the subject of the composition of the ashes of wood. They contain potash, and sometimes soda and silica, and so forth. We require a fresh series of analysis of the ashes of wood. There is also lime and magnesia. Alumina has been stated to be found in wood, but that I very much doubt. Then there is a small quantity of iron sometimes. Manganese has been found in the ashes of wood. There is also carbonic acid, derived no doubt from the incineration of some of the organic products existing in wood. There is phosphoric acid in every case. There is also a little sulphuric acid found. Those are the chief constituents. The term potash—wood ash—indicates the origin of that substance.

I think it may interest you to record a few statements concerning the rapidity of the growth of wood in different localities, as bearing upon the formation of coal, or the rapidity of the growth and production of coal. I have collected some observations upon this subject from the papers of Chevandier, who has paid great attention to the subject, and whose papers you will find in the *Annales de Chimie*, published several years ago. He ascertained that on the western slope of the Vosges Mountains, and in the plain extending from their base, the average annual production of wood in forests of large beech trees is about 318 cubic feet per 2½ acres. The average weight of dry wood annually produced in these forests amounts, in round numbers, to 8050 lbs. avoirdupois per 2½ acres. This contains 3968 lbs. of carbon, and 57 lbs. of hydrogen in excess of that required to form water with the oxygen of the wood. He has calculated that a bed of coal containing 85 per cent. of carbon, corresponding to the annual growth of these forests per 2½ acres, would have an average thickness of $\frac{6}{1000}$ths of an inch, or $\frac{64}{10000}$ths. The produce of coppice wood is much influenced by the nature of the ground. In coppices the ground is not so protected from the dessicating action of the sun and winds. In the Black Forest, in the duchy of Baden, trees of hornbeam, a common plant in this country, produce annually 5644 lbs. of dry wood per 2½ acres. Trees of the common silver fir produce 8264 lbs.

To be continued.)

ACADEMY OF SCIENCES.

May 9.

MM. Bussy and Buignet continued their memoir "*On Hydrocyanic Acid.*" In this part they study the action of the acid on the chlorides of mercury. They show in the first place, that the bichloride has a strong affinity for hydrocyanic acid, retaining it with power, although forming no definite chemical compound. The protochloride is converted into the bichloride, with consequent separation of mercury. They also study the action of various salts and substances on the aqueous solutions of the acid, and show that a great number have the power of separating, though in different degrees, the water from the acid, which in some cases forms a distinct layer on the surface of the mixture. This paper is altogether of so much importance that we shall at a future time present it to our readers but slightly abridged.

A memoir "*On the Manufacture of Fatty Acids for Candles and Soaps,*" by M. Mege Mouries, was presented. This memoir suggests, rather than details, a cheap and easy method of separating stearic and oleic acids and glycerine. The author shows that in the ordinary state tallow is saponified with difficulty, while in the globular state, which may be induced by melting the tallow in water containing a little soap in solution, a small quantity of alkali easily attacks it, and when the mixture is raised to about 60°C. the alkali and glycerine quickly separate. The fatty acids can now be separated by placing the soap in water acidulated with sulphuric acid, whereupon the stearic acid will crystallise, and the oleic acid be obtained almost colourless with the sulphate of soda, and can then be made into soap. This seems an important process for manufacturers, and deserves attention. No precise details are given, but the method is clearly indicated in the paper, which we shall translate in full. The memoir elicited the commendations of M. Chevreul, who considered the process ingenious and simple.

We do not meddle much with medicine, but we may mention here that a curious *case of diabetes* in a monkey was related to the Academy by M. Berenger-Feraud. The author brought two monkeys from Algiers, and in the hope of saving them from pulmonary consumption, tried to persuade them to live on a mixed diet of animal and vegetable food. One positively declined, and soon died of acute tuberculosis. The other adopted the mixed diet, and stood the cold well for a time, but unmistakeable symptoms of diabetes manifested themselves, and this monkey also died after a residence of nine months in France.

NOTICES OF BOOKS.

Journal für Praktische Chemie. Nos. 6 and 7. 1864.

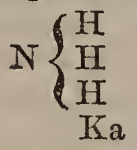
The two numbers of the above-named Journal have arrived too late to allow us to give more than the titles of some papers. The former, however, contains two papers which merit an abridged translation; but this we must for the present defer. One is, "*On the Analysis of Silicates,*" by Werther. There is nothing very novel in the method given, but it may be useful in some instances. Another paper by Winckler, "*On Cobaltic Acid,*" leaves no doubt of the existence of this body, and corrects an error into which the author had fallen in a former paper. He then gave the formula of cobaltic acid as CoO_5; recent results have led him to adopt the formula CoO_3. The other papers in this number either have no interest for the generality of our readers, or have already appeared in the Chemical News.

The next number opens with the first part of a generally careful and accurate paper by Werther "*On Thallium,*" to which we shall return when it is concluded. A communication by Rammelsberg follows, "*On the Native*

Compounds of Vanadic Acid and Lead Oxide;" and we have a lively and interesting essay by Scheerer, entitled "*Has Silicic Acid the Composition* SiO_2 *or* SiO_3*?*" and in which the question is fully discussed in all its relations.

Poggendorff's Annalen der Physik und der Chemie. No. 4. 1864.

Among some valuable papers on various subjects in physics, we find in this number an account by Weyle of some *metallic ammonium compounds*, which will interest the reader. The author appears to have obtained some curious compounds of ammonia with potassium and with sodium, and also with sodium amalgam. The potassium compound he describes as an ammonium in which the fourth equivalent of hydrogen is replaced by potassium.



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The paper presents several novelties, and merits translation at length.

Other papers—"*On the Formation of Ice in the Sea,*" "*On the Theory of the Leyden Jar,*" and "*On the Theory of Light,*" are of that recondite character which makes them so valuable to the readers of *Poggendorff*.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

999. Henri Adrien Bonneville, Rue du Mont Thabor, Paris, "A new method of obtaining a semi-fluid or solid product obtained by concentrating the saponaceous parts of the quillai tree."—A communication from Emeric de Werchin, Maubeuge, France.—Petition recorded April 21, 1864.

1021. James Edward Duyck, Stamford Street, Blackfriars, London, "Improvements in treating petroleum and other hydrocarbon oils and fats or fatty bodies."—Petition recorded April 22, 1864.

1058. Bonnet Frederic Brunel, Brussels, Belgium, "Improvements in treating titanic iron sands, and in apparatus employed therein."—Petition recorded April 27, 1864.

Notices to Proceed.

3294. Jean Michel Vanderfeesten, Brussels, Belgium, "Improvements in apparatus for heating, boiling, evaporating, and distilling."—Petition recorded December 30, 1863.

3307. John Dale and Heinrich Caro, Manchester, Lancashire, "Improvements in obtaining colouring matters for dyeing and printing."—Petition recorded December 31, 1863.

10. Jean Louis Prosper Duroy, Faubourg Montmartre, Paris, France, "An improved method of manufacturing soap with a vegetable basis.

16. William Balk, Woodbridge Road, Ipswich, Suffolk, "Improvements in furnaces applicable in the smelting of ores and in the melting of metals."—Petitions recorded January 2, 1864.

192. Frederick North, Leeds, Yorkshire, "Improvements in processes and apparatus for treating and preparing peat and turf, and the products obtained therefrom"—A communication from Charles Fluery, Bruxelles. —Petition recorded January 23, 1864.

225. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in stopping bottles containing aërated liquids."—A communication from Edward Hamilton, Chicago, U. S.

263. William Clark, Chancery Lane, London, "Improvements in effecting the combustion of certain matters for heating purposes, and in apparatus for the same."—A communication from Francis Bernard de Keravenan, Boulevart St. Martin, Paris.—Petition recorded January 30, 1864.

283. Edward Beanes, Argyle Street, London, "Improvements in preparing or treating animal charcoal."—Petition recorded February 3, 1864.

292. Henry Edwin Drayson, Southampton, Hampshire, "An improvement in the manufacture of gunpowder."—Petition recorded February 4, 1864.

512. William Ibotson, Wraysbury, Middlesex, "Improvements in the manufacture of paper and in machinery employed therein."—Petition recorded March 3, 1864.

925. Frederick Albert Gatty, Accrington, Lancashire, "Improvements in treating garancine and other products of madder."—Petition recorded April 27, 1864.

CORRESPONDENCE.

Bankers' Cheque Paper.

Mr. Barclay, the patentee of the cheque paper mentioned by Mr. Heaton in No. 225 of the Chemical News, makes the following statement :—

That he is prepared to show that the process pointed out by Mr. Heaton for the evasion of the security of his patent cheque paper is *not* (as stated by Mr. Heaton) successful.

That, in combination with other means in ordinary use in printing and preparing bank cheques, his paper offers the best method of protecting a cheque from an alteration by chemical reagents which has hitherto been brought into *practical use*, and that the principles thus involved are sanctioned by some of our best chemists when required to give their views a practical form ; but that he cannot enter into the question until the controversy in the *Bankers' Magazine* has closed, and that he has there stated that the attack there made upon him was founded on a failure of the parties in question in a fair trial, before a banker, successfully to extract portions of writing from certain cheques furnished and fully approved by him.

MISCELLANEOUS.

YOUNG *v.* FERNIE.

This was a trial for an alleged infringement of a patent. It is within the knowledge of most of our readers that in December, 1850, Mr. James Young took out a patent for "Improvements in the treatment of certain bituminous mineral substances, and in obtaining products therefrom." The specification proceeds to describe the invention as consisting in treating bituminous coals in such a manner as to obtain therefrom an oil which the patentee calls paraffine oil, and from which he obtains paraffine. The specification continues :—"The coals which I deem best for this purpose are such as are usually called parrot coal, cannel coal, or gas coal, and which are used in the manufacture of gas for the purpose of illumination, because they yield upon distillation at a high temperature olefiant and other highly illuminating gases in considerable quantities ; and although some coals last described contain a large amount of earthy matters, those matters do not interfere materially with my process. To obtain paraffine oil from coals, I proceed as follows :—The coals are to be broken into small pieces of about the size of a hen's egg, or less for the purpose of facilitating the operation. The coal is then to be put into a common gas retort, to which is attached a worm pipe, passing through a refrigerator, and kept at a temperature of about 55° F. by a stream of cold water. The temperature of the refrigerator should not be kept too low, lest the product of the distillation should congeal and stop the pipe, and I find that a temperature of about 55° F. is sufficient. The retort being closed in the usual manner, is then to be gradually heated up to a *low red heat*, at which it is to be kept until volatile products cease to come off. Care must be taken to keep the temperature of the retort from rising above that of a low red heat, so as to prevent as much as possible the products of the process being converted into permanent gas.'' Much of the remainder of the specification is unimportant to the present case, and we only extract a few more sentences. As regards the temperature to be employed it is further stated:—But in order to obtain the largest quantity of crude paraffine oil from coals by means of this process, and produce the smallest quantity of permanent gas by the action of the heat employed, whatever may be the apparatus used, care must be taken to heat the coals gradually, and to employ the *lowest temperature* necessary to complete the operation. Then after describing the method of purifying the paraffine, the specification concludes as follows:—"Having thus described the nature of my invention, and the best means with which I am acquainted for performing the same, I hereby declare that I claim as my invention the obtaining of paraffine oil, or an oil containing paraffine and paraffine from bituminous coals by treating them in the manner hereinbefore described.'' Such is the patent alleged to be infringed. The defendants, as we gather from the speech of Mr. Grove, assert a want of novelty in the invention; and, further, that they obtain their oil at a lower temperature than a low red heat—the temperature specified; but this will appear in the evidence. It is unnecessary to say that we shall confine ourselves entirely to the chemical evidence, and give this in as condensed a form as possible. The first witness called was Dr. Hofmann,* who, in his examination in chief, stated that he knew Mr. Young's process, and was acquainted with the substances paraffine and paraffine oil. Paraffine he knew as a scientific curiosity before 1850, but did not at that time know that it could be produced from coal. Mr. Young has stated the coal to be employed in the manufacture, and the heat to be employed. The heat is to be applied gradually up to low redness. Low redness may be said in round numbers to lie between 800° and 1000° F.—a heat which just becomes visible in the dark. It is well known and distinguished from a bright or cherry red. In the distillation the condensing tubes must be kept moderately warm to prevent the solidification of the paraffine. The product of the distillation is an oily substance called paraffine oil, which deposits a solid substance paraffine, held in solution by the oil. These products arise from the exposure of a peculiar coal mentioned in the patent to a temperature mentioned in the patent. At a lower temperature than that mentioned you would get none, or only very little of these products. At a higher temperature you would get gaseous products and others, which differ from paraffine and paraffine oil. Gas and tar are obtained above 1000° F. Paraffine can be got from tar in minute quantities, but not commercially. Crude paraffine oil and tar differ essentially in their properties, both physical and chemical. No one to my knowledge obtained paraffine and paraffine oil for commercial purposes from coal before Mr. Young. Since then the subject has attracted much attention, and the article has become of great commercial value. I have read a good deal about paraffine, and can state that before 1850 it was only known as a chemical curiosity. No practical mode of obtaining it was known before that time. I believe Mr. Young's invention was new at the date of the patent, and that any workman by following the directions of the specification could produce paraffine and paraffine oil. I am aware that before 1850 other persons had attempted to produce paraffine from peat, from schist, and, I believe, from tar; but, according to my belief, had not succeeded in producing it from coal. At certain temperatures above a low red heat naphthaline and paraffine are produced together. I know no practical mode of separating these bodies. Naphthaline is not practically produced in Mr. Young's process. Naphthaline is produced in the manufacture of gas. Paraffine may be regarded as olefiant gas in a solid form; at a high temperature paraffine oil may be converted into gas, but at present chemistry has not practically enabled us to convert gas into paraffine. I have looked at a number of documents which have been placed in my hands, and am prepared to answer any questions put by the defendant's counsel.

Cross-examined by the Attorney-General: I know that paraffine had been obtained from coal before Mr. Young produced it. The description in Mr. Young's patent includes a considerable variety of coal—all bituminous coals. Gas coal may be taken to mean coal from which gas is made for commercial purposes, such varieties of coal as from their yielding large quantities of olefiant gas are particularly desirable for a gas manufacturer. The term "gas coal'' I understand to apply only to such as give large quantities of olefiant gas. There are other illuminating gases which have the power of producing the oil, propylene, butylene, amylene, and several others, which, for practical purposes, are comprised under the term olefiant gas. Marsh gas would practically be comprehended in the term. According to our present knowledge, we attribute the highly illuminating power of coal gas to olefiant, and the other gases I have mentioned which have the same composition as olefiant gas. I believe all gas coals are fit to produce, for profit and commercially, paraffine and paraffine oil by Mr. Young's process. I am not practically acquainted with any Newcastle coal which will produce paraffine oil commercially by the process. I have never seen any coal distilled but that I distilled myself, which was Boghead. This is a peculiar kind of coal. A great variety of similar coals are known. It has been discussed very considerably whether Boghead coal should be classed as a coal or a shale. There is a great difference in the appearance of Boghead and Newcastle coal. The former resembles in some points Dorsetshire shale. I distilled specimens of Dorsetshire shale, and found that they yielded oil, but only minute quantities of paraffine. Boghead coal yields a much larger quantity. Those coals which yield a highly illuminating gas will yield a larger proportion of paraffine. I cannot say, without analysing it, whether the specimen handed to me is Boghead mineral. It keeps a white stroke when scratched, which is characteristic of Boghead. Boghead mineral is found in direct connection with what is commonly termed coal. [The Attorney-General handed up another specimen, showing, he said, the point of junction of one coal passing, as it were, into the other.] In this second specimen there is considerable difference in the two scratches; one is white, the other black. It may be that this would naturally happen with respect to that portion of the Boghead which lay next the coal. I believe in many cases beds of shale pass into beds of coal. The shale I received from Dorsetshire in some respects resembled, and others differed essentially from Boghead coal. It is not always easy to distinguish coal from shale. I am not certain at what temperature I distilled Dorsetshire shale, but I remember distinctly that it was considerably above the fusing point of lead (620°). The products I obtained were in many respects like those procured from Boghead cannel. I distilled three specimens, and obtained different quantities of mineral and volatile matter. No. 1 contained 80·49 mineral matter, and 19·52 volatile; No. 2, 47·2 mineral, and 52·8 volatile; and

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* Dr. Hofmann, as the principal witness for the plaintiff, was under examination three days. Our report will necessarily be a mere abstract of his evidence, but it is given in the first person to avoid a troublesome circumlocution.—Ed. C. N.

No. 3, 26 mineral and 73·3 volatile matter. Of the volatile matter, a portion was oily, and a portion gas and water. In the lowest instance 100 parts of shale yielded 14·6 parts of oily matters. In another experiment this quantity rose. When ordinary coal is distilled the quantity of mineral matter found varies. Carbon is a mineral matter—a mineral component of vegetable matter. In the analyses spoken of I mean fixed mineral matters, all the carbon being burnt. I saw paraffine candles in the Exhibition of 1851; they were made from schistus. I did not see the schistus. A white mark left when a specimen is scratched with a knife indicates a considerable quantity of mineral matter. Ordinary coal does not usually leave a white mark. I would endeavour by distillation to ascertain whether a substance was coal or shale. Coal on distillation leaves coke behind; Boghead material leaves coke behind, but it is an inferior coke, and yet a *bonâ fide* coke, which will burn in atmospheric air—not mere ash. I am not certain that I have burnt it. Coals vary to a great extent, and from my notes I find that the quantity of ash in *bonâ fide* coals varies between one-half per cent. and 30 per cent. The proportion of ash is not least in the more highly bituminous coal. In anthracite coal you have occasionally very minute quantities of ash. In cannel coal the proportion of ash is large. [The examination here related to the physical differences between cannel coal, ordinary coal, and schists, and the witness remarked that he must confine himself to his own department of science.] It is difficult to tell the coal from shale; the two substances are so allied that it is only by a sort of compound analysis that I, as a chemist, have formed an idea of the difference. One of the most striking characteristics of shale and schist is the formation during distillation of a large quantity of nitrogenous volatile compounds, distinguished by their repulsive odour. A chemist is a bad judge of odour; he gets so many; still, I would say that the odour of Boghead is eau-de-Cologne, when compared with the odour evolved in the distillation of schist. My attention has been drawn to the specification of Du Buisson, 1845. [The patent is entitled "Furnaces apparatus, and processes for the distillation of bituminous substances, and treating the products thereof," and the specification describes furnaces and apparatus for distilling bituminous schistus, and obtaining—1, a liquid bitumen, or raw oil of schistus; 2, a light oil which may be burnt in lamps; 3, a greasy oil for lubricating, and containing paraffine; and lastly, 4, paraffine itself.] The paraffine in this process appears the same as obtained by Mr. Young; the oils may be different, similar in appearance and application, but different in composition. So few chemical properties are given that it would be impossible to identify them with Mr. Young's. The description, as far as it goes, is very similar to Mr. Young's. There are differences in the two processes and the materials. Du Buisson describes schistus as consisting of animal and vegetable remains, and in the process steam passed through red-hot pipes and a red heat are employed. Steam passed through a red-hot pipe would become red hot. Mr. Young used a low red heat, and we distinguish between a red heat and a low red heat. By exceeding a low red heat some of the useful products would be transformed into gaseous matters and naphthaline. The quantity of paraffine and paraffine oil is diminished as the temperature is raised; but the absence of naphthaline would not be a criterion that the process had been carried out at a particular temperature. If the products are identical, I should infer that the materials used and the processes were the same. Different substances may require different temperatures. Different coals might require different heats, and so might shales. My attention has been called to Hompesch's patent, 1841. [This was a patent for obtaining oils from bituminous matters, such as schiste, clay slate, and asphalte. The specification describes an apparatus in which the material is gradually heated from 100° R. (257° F.) to 200° R., and subsequently to a red heat. In this way three separate oils are to be obtained—an essential oil, an intermediary or fat oil, and a thick oil.] It would be impossible to say whether these oils are the same as Mr. Young's. I would say they are not, because I find that the patentee describes particular processes for removing smells from this oil. The oils from schist have a very bad smell. Some people object to the smell of those from coal; but I would not compare the odour of the crude product from Boghead coal to that of the crude product from schist. In the process of De Hompesch there is a gradual raising of temperature to a red heat. Taking the process described by De Hompesch, I believe the products would be different from Mr. Young's. In the first place, the former collects the products in three different parts. He collects the first at 100° R.; if Boghead was exposed to this temperature nothing whatever would be obtained. In the second stage of the operation. the charge is maintained at a temperature of 200° R.; and I have no hesitation in expressing my belief that at that temperature Boghead would give out nothing whatever. Lastly, he pushes forward the charge to that part of the retort which is maintained at a red heat; and at that temperature the results would be entirely different. Paraffine and paraffine oil would, in fact, be destroyed at that temperature with the formation chiefly of gas and naphthaline, and the resulting products would be inapplicable to the purposes for which Mr. Young employs paraffine and paraffine oil. The apparatus, as described, involves the necessity of a passage from a lower heat to a red heat, but it is obvious that the products pass through a red heat, and that they are decomposed, and that I consider an essential difference between the statement of Mr. Young and Count de Hompesch. The first part of the latter's retort is to be kept at 100° R., the second at 200° R., and the third is kept at a red heat. It is obvious that as the heat is applied to the same apparatus, there must be a point of transition between 200° R. in the second compartment, and 1000° or 1200° (F.) of the third compartment. But it is distinctly stated that the third compartment is to be heated until it becomes red hot, and therefore I do not know at which point the material is kept at a *low red* heat. I would say that at a certain section of the retort it must traverse a *low* red heat, but the compartment itself, as I read the specification, is to be kept at a red heat. Hompesch's oils must be essentially different from Mr. Young's, since they are obtained at temperatures at which I believe Mr. Young's are never procured. The temperature of the second compartment (200° R.) is so low that you might expose Boghead coal to it for a fortnight without expelling a trace of oil. Coal tar is an ill-defined substance; what is generally called by the name is a secondary product obtained in the distillation of coal for gas. Such tar generally contains naphthaline. I do not know that the term has been applied to the substance which Mr. Young produces, or to a similar product either here or on the Continent. I am acquainted with the works of Reichenbach, and have had my attention called to extracts from them. [Reference was then made to an experiment in which Reichenbach distilled coal and obtained ammoniacal water, and what he called empyreumatic oil or *coal-tar*.] There is nothing in the passage quoted to show that Reichenbach's product corresponded with Mr. Young's crude oil. Nothing is said about the oil depositing paraffine, which Reichenbach would certainly have mentioned. The empyreumatic oil may or may not have contained paraffine, but it is not stated in the passage. Whether it did contain paraffine would in a measure depend on the kind of coal submitted to distillation. I cannot say whether there are any bituminous coals from which no paraffine can be obtained. [Another passage from Reichenbach's work was here read, in which he again speaks of the product obtained by distillation as *coal-tar*, and mentions that in the rectification of the tar the first half of the distillate was a thin liquid oil, and the second half a thick oil containing paraffine.] This passage proves that Reichenbach first discovered that paraffine could be produced by the destructive distillation of coal. He states that paraffine is a product of the carbonisation of all organic substances, and he had obtained it from various woods, from coal, and from Dippel's oil. [Another extract was now read, in which Reichenbach gives instructions for obtaining the "tar" without naphthaline. He states that the vessel in which the coal is distilled must never be allowed to become red hot. In this way he says he always obtained "tar" composed of piccamar, eupion, creosote, paraffine, moder, and sulphur, but never naphthaline. Above redness he always obtained some naphthaline.] The product obtained by Reichenbach would be similar to Mr. Young's if similar coal was employed. Purified paraffine oil is not the same as eupion, which, according to Reichenbach, is a well-defined chemical compound, having a constant boiling point of 336° F., while Mr. Young's oil boils between 280° and 550° F. From this I would give it as my deliberate opinion that Mr. Young's oil cannot be identical with eupion. I should say that eupion is not the principal constituent of Mr. Young's oil, which, I believe, is composed of a number of substances identical in composition with paraffine, and other substances which differ from the composition of paraffine by containing a slight quantity of hydrogen in addition. In the purified paraffine oil there is still some paraffine; I would venture to undertake the separation of more or less from all the paraffine oils in commerce.

(To be continued.)

Pharmaceutical Conversazione. — On Tuesday evening the President and Council of the Pharmaceutical Society received a large company at their rooms in Bloomsbury Square. Many objects of great interest were displayed in the rooms. In one was a collection of living exotic medicinal plants, amongst which we noticed a very flourishing specimen of the *Physostigma Venenosum.* In the library was a large collection of electric telegraphic apparatus and other objects of interest. In the lecture-room Mr. Abel gave a short lecture on gun-cotton, Mr. Ladd showed acoustic figures on the screen, and Mr. Claudet took a photograph by means of the light from burning magnesium wire. The *conversazione* was well attended, and the guests were extremely gratified.

Pepsine from the Pancreas.—A lecture by Dr. Corvisart contains a hint for the makers of pepsine. The Doctor removed the pancreas from a man who died suddenly after inhaling chloroform, cut it into small pieces, and shook them up with 400 grammes of cold distilled water. After filtration, one portion of this liquor was rendered slightly acid with hydrochloric acid; another portion was made alkaline with potash, and the third part was left as it was. The digestive power of each was then tested with fibrin and albumen, the mixture being kept at about 40° C., and in every case the digestion was rapidly effected.

How to View the Sun through the Telescope.—To use the full aperture of the telescope is of paramount necessity either in viewing the sun or planets. If the extinction of the light is effected by coloured glasses, the best combinations I have yet found are—first, that of two plane glasses of a shade between brown and violet, with one of a grass-green hue interposed; or second, of two green glasses, with a blue one coloured by cobalt between them. These allow scarcely any rays of the spectrum to pass but the yellow and less refrangible green; and they cut off almost all the heat. The perfection of vision is attained by using only the extreme red rays; but glasses which transmit these cannot be used on account of the heat they allow to pass. Whatever combination of glasses be used, they are, however, apt to crack and fly to pieces through the heat which they do intercept.—*Sir John Herschel in the Quarterly Journal of Science.*

Action of Fire on a Corpse.—When fire is applied to a living body a blister filled with liquid is soon raised, and if the heat be continued the epidermis is destroyed. But when the same heat is applied to a dead body the epidermis rises in the form of a blister, which is filled with vapour, and which presently bursts. This test has been proposed by M. Martin de Cordoux, to ascertain whether a person is really dead before the body is interred. In performing the test, the author recommends a small flame, such as the flame of a match, to be applied for a short time at about half a centimetre from the skin.

Poison Bottles.—Poison bottles and poison corks, poison caps and poison stoppers, have all successively been tried, with the object of preventing careless or sleepy nurses from giving medicines out of the wrong bottles and thereby poisoning their patients; but they are all open to the objection that when the liquid for which they have been originally used is exhausted, the very nice-looking bottle is generally replenished with eau de cologne, tincture of senna, or such like innocent compounds, and the object of having a peculiarly-contrived bottle is thereby defeated. Perhaps the most unobjectionable of all these attempts to substitute a mechanical contrivance for ordinary caution and common sense, has been recently brought forward by Mr. Thonger before the Pharmaceutical Society. It consists of a patent label having a border of sand-paper round it, thus appealing strongly to the sense of touch, which is presumed will warn the holder that danger is near. These labels are applicable to dispensing bottles and to the smallest phials, and possess an advantage over any other contrivance, as they can be stuck on any vessel, and as readily removed when the poisonous contents are done with, and the bottle is required for something else.—*Chronicle of Chemistry in the Quarterly Journal of Science.*

Movements of Clouds.—M. Andrès Poey has addressed a letter to *Les Mondes* on the agrimuthal rotation of clouds. He states that he hopes to be able to demonstrate that the law of the rotation of winds put forth by M. Dove is perfectly applicable to clouds, and that it is even the rotatory direction of clouds which determines the rotation of the wind beneath and modifies the general meteorological phenomena. He gives the law of M. Dove as follows:—"1st. When upon the north hemisphere the currents of air coming from the equator alternate with the polar currents, the wind makes the tour of the compass most often in the direction of south, west, north, east, and south. 2nd. In the southern hemisphere it is the reverse, namely, south, east, north, west, and south. 3rd. The influence of the wind on the meteorological phenomena, combined with the law of its change, affect two opposite halves of the compass under all relations, the region of the east and that of the west, in which the atmospheric variations present a correspondence which it is easy to observe." In order to establish the circular movements in the atmospheric currents, he eliminated all the clouds of transformation which would have masked the general result of the circulation, and all the partial and isolated rotations of the wind, as also the effects of the sea-breeze. He attempts the explanation of the occurrence of rain and of other meteorological phenomena.

ANSWERS TO CORRESPONDENTS.

J. T. B.—The balance was made by Lard and Oertling specially for us.

M. P. S.—We shall give attention to the subject.

E. B.—The bill, it is said, will be presented to Parliament this session, but is not likely to receive much attention this year.

Erratum.—Last number, p. 230, in the formula of atropine and tropine, *for* Ag *read* Az.

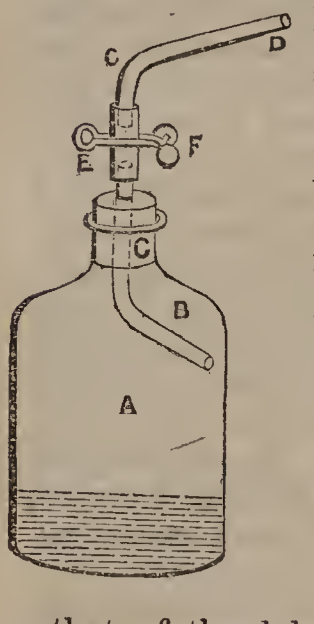
Received.—A. W. Whitelaw; W. S. Gibbons.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

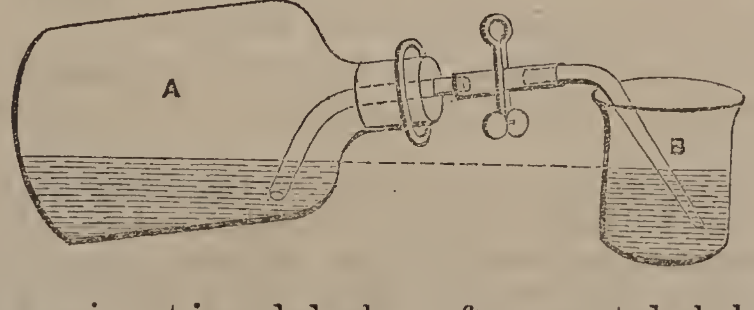
On the Volumetric Estimation of Tannic and Gallic Acids, Iron, Manganese, &c., by Moritz Mittenzwey.*

The known disposition of tannic acid in alkaline solution to absorb oxygen from the air affords an excellent means of estimating this body for technical purposes. The estimation can be conveniently made in the simple apparatus here figured and described.

The air in a bottle (A), capable of holding about a litre and a-half, communicates with the atmosphere by the bent tubes (B) and (C), the latter being drawn out at the end (D) to the diameter of about one or one and a-half millimetres. The two glass tubes are united by means of a moderately long piece of india-rubber tubing (E), provided with a pinchcock (F) to close it; and the lower glass tube is fixed in the neck of the bottle by a bored cork, or, better, a caoutchouc stopper (G).



In executing the analysis it is absolutely necessary that the air in the bottle should be perfectly renewed, and the temperature of all reaching the fluid be the same as that of the laboratory. As soon as the absorbing lye (which should amount to 150 or 250 c.c.) is prepared, the bottle should be perfectly closed, and then the pinchcock opened just for a moment, so that the pressure of the internal and external air may be equalised. The absorption of the oxygen is then hastened by strongly shaking the bottle, which must be wrapped in a cloth to avoid raising the temperature by the warmth of the hand. After each shaking, water must be allowed to flow into the bottle (A) from a weighed quantity in a beaker (B, Fig. 2), so that the fluid in the two vessels may attain the same level, as shown in the drawing.



The experiment is ended when, after repeated shakings, no more water runs from B to A, and the difference in the weight of the water in the beaker *in grammes* gives the amount of oxygen absorbed in cubic centimetres, which can be corrected for the standard temperature and pressure.

I. For Gallic and Tannic Acid.—Place in the bottle about 200 c.c. of a 3 per cent. potash or soda solution, then drop in one gramme of tannic or gallic acid loosely wrapped in paper, and proceed as above described. The absorption is at first rapid, and in the case of gallic acid is soon complete; with tannic acid a longer time is required.

One gramme of tannic acid will absorb the same amount of oxygen as 0·7 gramme of gallic acid, namely, 175 c.c. at 20° C. In twelve experiments the greatest variation in the case of tannic acid amounted to only 2 c.c., and with gallic acid only 1·2 c.c. From six to ten experiments can be carried on simultaneously with ease, and indeed with advantage.

The best alkaline solution to use is a soda solution containing 2 or 3 per cent. of caustic soda, or a potash solution with from 3 to 5 per cent. of the caustic alkali. Experiments have proved strong solutions to be useless; for example, one gramme of tannic acid in a potash solution containing 35 per cent. of alkali only absorbed 22 c.c. of oxygen. Further experiments confirmed this unexpected result.

It has been already remarked that gallic acid absorbs oxygen with much greater readiness than tannic. One gramme of tannic acid, after shaking for 60 seconds, only absorbed 23·4 c.c.; while 0·7 gramme of gallic acid, after shaking for the same time, absorbed 71 c.c. of oxygen, the same proportion of each acid taking up when the absorption is complete one and the same volume (175 c.c.). We have here an indication of a means of estimating the two acids in the presence of each other. Suppose, for example, we have a substance, 2 grammes of which absorb 140 c.c., this will answer to $\frac{140}{175}$ = 0·800 grammes of tannic acid, or to $\frac{140}{175}$.0,7 = 0·560 of gallic acid. For a second and decisive experiment, we now weigh as much of the substance as should combine with 175 c.c., in this case 2. $\frac{175}{140}$ = 2·500 grammes, and shake this strongly with the lye for 60 seconds. Suppose, after this, we have 40 c.c. absorbed, we have then a decisive proof of the presence of both acids, and we can draw a conclusion as to their respective proportions.

It must be observed that in these experiments an equal weight of the substance, equally strong alkaline solutions, and a flask of equal size, and of similar form (about 1·4 litre capacity), are indispensable conditions.

The following table, which gives the means of the numbers obtained in three experiments after shaking for sixty seconds, show sufficiently concordant results:—

1·000	grammes	Tannic acid	absorbed	23·4 c.c.
0·000	,,	Gallic acid		
0·900	,,	Tannic acid	,,	27·5 c.c.
0·070	,,	Gallic acid		
0·570	,,	Tannic acid	,,	44·0 c.c.
0·300	,,	Gallic acid		
0·200	,,	Tannic acid	,,	61·0 c.c.
0·560	,,	Gallic acid		
0·000	,,	Tannic acid	,,	71·0 c.c.
0·700	,,	Gallic acid		

A rather roundabout but quite conclusive experiment may be made in the following way:—The mixture to be estimated is dissolved in a known quantity of water, and the tannic precipitated by gelatine; the gallic acid solution is then transferred to the absorption bottle to be estimated. A second experiment is then made with the mixture, and so all necessary data for the calculation are obtained.

In making use of the process to determine the tannic acid in leather, gall nuts, sumach, bark, &c., we proceed in the same way as with pure tannin. If the amount of tannic acid usually present in the substance is not already known, it is advisable to make a preliminary experiment with a small quantity, and afterwards proceed with the quantity calculated to absorb 175 c.c. By a parallel experiment made with one gramme of tannin and shaking for 120 seconds, the amount of gallic acid will be discovered.

This method of analysis is only available for the ordinary commercial substances. Whether all the so-called tannic acids have the same capacity for the absorption of oxygen as ordinary tannic acid is as yet undetermined.

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* *Journal für Prakt. Chemie*, No. 2, 1864, p. 81.

To Estimate Tannin in Leather.—From 4 to 7 grammes of the leather is cut into the thinnest possible slices, which are digested in about 200 c.c. of warm water; after cooling from 7 to 10 grammes of stick potash wrapped in paper is dropped into the flask, and the shaking proceeded with.

With *sumach and oak bark* the same method is followed, or a hot-filtered decoction is used. The results with the decoction always differ from those with the substance itself, the latter being higher, which seems to show that a portion of the tannic acid withstands the solvent action of the water.

Gall nuts, catechu in powder may be estimated in the same way as pure tannic acid.

II. Iron Compounds.— These must be reduced to the state of protoxide by means of zinc, and the excess of acid neutralised with caustic potash or soda. (Ammonia and the carbonated alkalies must be avoided.) The solution is then poured into the absorption-flask and pieces of potash wrapped in paper are then dropped in. The absorption is complete in a very short time. For accuracy this process is second to none, and may be recommended in preference to that of Margueritte and Fuchs, since it requires fewer precautions. 50 c.c. of a solution of protoxide which contained 1·395 Fe absorbed in three experiments 148·0 c.c., 148·44 c.c., and 148·4 c.c. of oxygen at 19° C.; the mean = 148·28 c.c., which at this temperature weigh 0·1987 grammes, answering to 1·391 grammes of iron.

III. Manganese Compounds.—As these are easily reduced to the state of protoxide, the estimation is made in the same way as in the case of protoxide of iron, but it is necessary to know to what extent the protoxide of manganese unites with iron. Further experiments are required to determine this point, and the following proportional numbers are only the results of some few experiments that have led to the conclusion that one part by weight of absorbed oxygen corresponds to 4·34 parts by weight of manganese, which may be calculated as the oxide Mn_5O_9. In the absence of more complete researches it is superfluous to discuss the rational formula of the resulting oxide; but one thing is certain—namely, that the oxidation does not proceed so far as the state of binoxide.

The estimation of manganese in the presence of iron is performed in two operations—one with the iron in the state of protoxide, and the other with the iron in the state of peroxide, and the absorption observed in the two cases. The combination of the two results will give the desired explanation.

Active oxygen may be estimated in a similar way, by means of a solution of protoxide of iron.

Indigo may be valued in the following way:—In a well-closed glass bottle finely-powdered indigo is reduced by means of potash or lime and a protosalt of iron, under a layer of mineral oil. When the precipitate has completely deposited, a certain volume of the clear solution of indigo-white is removed by means of a pipette, care being taken that a layer of oil swims on the surface of the solution. The pipette is then emptied into the absorption bottle, which must also contain oil, and the shaking is continued until the indigo blue is re-formed.

According to theory, 8 parts by weight of combined oxygen answer to 131 parts of indigo blue; or, for one gramme of indigo blue 45·7 c.c. of oxygen at 20° C. are required. From these numbers we may see at once what degree of accuracy this way of analysing indigo promises.

TECHNICAL CHEMISTRY.

Conversion of Salt Meat into Fresh; a further Application of Dialysis, by A. A. Whitelaw.

As an appendix to the notice of my process for the utilisation of brine (published in the Chemical News for March 26), I now beg to direct attention to a modification of that process, applicable to ships at sea, by which the quality of the meat supplied to the men may be much improved, and their food varied.

The salt meat is placed in a dialytic bag made of untanned skin, or other suitable material, and the bag filled nearly, but not quite, full of brine from the beef barrel. The dialyser is then placed in sea water, and the process allowed to go on for several days, till the meat and brine are sufficiently fresh for use, or till the brine in the dialytic bag is within 1° or 2° of Twadde's hydrometer of the same strength of sea water. In this way, as the brine becomes freed from salt, the beef, which, by the action of salt, has been contracted, gives its salt to the brine in the bag, and so the process goes on, the beef expanding like a sponge, and gradually taking up a great part of the natural juice that it had previously lost in the salting process. In this way no loss of juice is sustained by steeping, and the brine left in the bags, after a nightly dialysis in fresh water, can be used for soup.

Thoroughly salted beef, without bone, takes up nearly one-third its weight of juice, and this absorption takes place gradually as the strength of the brine in the dialyser becomes reduced.

Meat thus treated—being, in fact, fresh meat—may be cooked in a variety of ways that are obviously not available for salt meat; and so the food of sailors, and, consequently, their health, may be improved.

55, Sidney Street, Glasgow.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 15, 1864.

"*On the Chemical History and Application of Gun-cotton,*" *by Professor* Abel, *F.R.S., Chemist to the War Department.*

The history of gun-cotton affords an interesting illustration of the facility with which the full development of a discovery may be retarded, if not altogether arrested, for a time, by hasty attempts to apply it to practical purposes before its nature has been sufficiently studied and determined. When Schönbein, in the autumn of 1846, announced that he had discovered a new explosive compound, which he believed would prove a substitute for gunpowder, the statement attracted general attention, and attempts were made with little delay in different countries to apply the material to purposes for which gunpowder hitherto had been alone used. Schönbein, and Böttger (who appears to have discovered gun-cotton independently shortly after the former had produced it) lost little time in submitting their discovery to the German Confederation; and a committee was appointed for its investigation, by whom gun-cotton was eventually pronounced inapplicable as a substitute for gunpowder.

In this country, gun-cotton was experimented with immediately after the method of its preparation was published by Schönbein. Researches were instituted into its nature, preparation, &c., by Porrett and Teschemacher, John Taylor, Gladstone, and others. A few experiments were made on its application as a propelling and mining agent, and the manufacture of the material upon a considerable scale was set on foot by Messrs. Hall, the well-known gunpowder-makers at Faversham, a patent having been previously taken out in this country for the production of gun-cotton according to Schönbein's process. This factory had, however, not been long in operation before a very disastrous explosion occurred at the works, by which a number of men lost their lives, and which was ascribed to the spontaneous ignition of the gun-cotton, by the jury who endeavoured to investigate its cause. From that time the manufacture of gun-cotton upon any considerable scale was abandoned in England, and no important contributions to our knowledge of this material were made until, in 1854, Hadow published the results of some valuable investigations, which served to furnish a far more definite knowledge regarding the true constitution and proper method of producing gun-cotton than had hitherto existed.

In France, gun-cotton was also made the subject of experiments as early as the winter of 1846, and its manufacture was carried on at the Government powder works at Bouchet, near Paris. Some interesting balistic experiments were instituted, under the direction of Piobert, Morin, and other men of eminence, with gun-cotton in comparison with different kinds of gunpowder, the results of which indicated that, for producing equal effects to those furnished by a given weight of gun-cotton, it was necessary to employ a double quantity of sporting powder, three times the quantity of musket powder, and four times the weight of cannon powder. It was also found that the best results appeared to be obtained by arranging the gun-cotton so that it should occupy the same space as the charge of gunpowder required to produce an equal effect; and other data were arrived at, which show that the investigators were being led to work in a direction similar to that afterwards so successfully pursued by Baron von Lenk in Austria. Unfortunately, however, disastrous explosions occurred at the works at Bouchet, one as early as March, 1847, in a drying chamber, and two, following closely upon each other, in 1848. One of these took place in a magazine near which it was believed that nobody had been for several days; the other occurred also in a magazine where gun-cotton was being packed, and on this occasion several lives were lost. These disasters appear to have put an end, until quite recently, to experiments with gun-cotton in France.

After the material had been pronounced upon unfavourably by the Committee of the German Confederation, one of its members, Baron von Lenk, continued to devote himself to its study, and with such success, it appears, that a Committee was eventually appointed by the Austrian Government in 1852 to inquire fully into the merits of the material. A sum of money was paid to Schönbein and Böttger in recognition of the value of their discovery, and an experimental manufactory of gun-cotton was established at the Castle of Hirtenberg, near Vienna. A particular form of cannon was devised by Baron von Lenk for employment with gun-cotton, of which a 12-pounder battery was established. The performances of these guns were considered sufficiently satisfactory to warrant the preparation of four more batteries, which were sent to the Army of Observation in Galicia in 1855, but did not go into active service. It appears that, in consequence of a want of uniformity in the effects of the gun-cotton, and of an injurious effect upon the guns, added probably to the prejudice entertained against it by the artillery, the material fell into disfavour, and its application in cannon was for a time abandoned. It was received, however, with much greater favour by the engineers, and was applied with great success to mining and submarine operations. Meanwhile, Baron von Lenk's labours to perfect gun-cotton as a material for artillery purposes were unceasing; and at the close of the Italian war the subject of its application was again thoroughly re-opened at the instigation of Count Degenfeld, then Minister of War, who had at an earlier period taken an active interest in Baron von Lenk's investigations. After upwards of one year's experiments, a system of rifled field and mountain-guns, to be employed with gun-cotton which had been elaborated by von Lenk, was introduced into the Austrian service. Thirty batteries of these guns were equipped, and it was considered as definitely settled that gun-cotton would before long be introduced into the service in the place of gunpowder, for artillery purposes. In 1862, however, an explosion occurred at Simmering, near Vienna, where both gunpowder and gun-cotton were stored, and this disaster appears to have fortified to such an extent the arguments which were adduced against the employment of gun-cotton by its opponents in the artillery service that its use in this direction was again put a stop to for a time. Ultimately a Committee of Investigation was appointed, which consisted in part of eminent scientific men, and which appears, after careful deliberation, to have reported highly in favour of the stability, and important properties as an explosive, of the material,—a report which was supported by the favourable opinion entertained of gun-cotton by the Austrian engineers, in whose name Baron von Ebner prepared a very complete and interesting account of the properties and effects of the agent, with particular reference to mining and other engineering operations.

Gun-cotton appears, therefore, to have been again restored to favour in Austria, but no official accounts have reached England up to the present time, with regard to its employment in the recent war operations in that country.

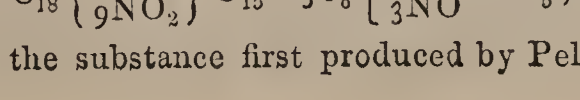
In the spring of 1862, full details relating to the manufacture and modes of applying gun-cotton were communicated by the Austrian Government to that of Her Majesty, and the War Office chemist was at once instructed to institute experiments upon the manufacture of gun-cotton, and upon its chemical constitution and stability. In the autumn of that year General Sabine directed the attention of the British Association to the results obtained with gun-cotton in Austria, and a combined committee of engineers and chemists was appointed to inquire into the subject. At the meeting of the Association in 1863, this committee presented a report, which was based upon information received partly from General von Lenk, who had been permitted by the Austrian Government to visit this country for the purpose of communicating fully with the British Association on the subject, and partly upon the results already arrived at in the experiments instituted by the lecturer under the direction of the Secretary of State for War. Subsequently a committee of investigation was appointed by the latter, under the presidency of General Sabine, composed of scientific men connected with the Royal Society and British Association, and of military and naval officers of considerable experience; and this committee has been entrusted with the full investigation of the properties of gun-cotton, as improved by Baron von Lenk, with reference to its applications to military, naval, engineering, and industrial purposes.

The chemical constitution of gun-cotton, concerning which the opinions of chemists were divided until 1854, has been conclusively established by the researches of Hadow. In the formation of substitution-products by the action of nitric acid upon cotton or cellulose, three atoms of the latter appear to enter together into the chemical change, and the number of atoms of hydrogen replaced by peroxide of nitrogen in the treble atom of cellulose—

$$C_{18}H_{30}O_{15} = 3(C_6H_{10}O_5)$$

may be nine, eight, seven, or six, according to the degree of concentration of the nitric acid employed.

The highest of these substitution-products is tri-nitro cellulose, pyroxilin, or gun-cotton,—



$$C_{18}\left\{\begin{matrix}H_{21}\\9NO_2\end{matrix}\right\}O_{15} = 3C_6\left\{\begin{matrix}H_7\\3NO\end{matrix}\right. \quad O_5;$$

this being the substance first produced by Pelouze in an impure condition, in 1838, by the action of very concentrated nitric acid upon paper, or fabrics of cotton, or linen, and afterwards obtained in a purer form by Schönbein, who employed a mixture of concentrated nitric and sulphuric acids for the treatment of cotton wool; the object of the sulphuric acid being to abstract water of hydration from the nitric acid, and also to prevent the action of the nitric acid from being interfered with by the water which is produced, as the chemical transformation of the cotton into gun-cotton proceeds. The formation of trinitro-cellulose is represented by the following equation:—

$$\underset{\text{Cotton.}}{C_6H_{10}O_5} + \underset{\text{Nitric acid.}}{3\left\{\begin{matrix}H\\NO_2\end{matrix}\right\}O} = \underset{\text{Gun-cotton.}}{C_6\left\{\begin{matrix}H_7\\3NO_2\end{matrix}\right\}O_5} + \underset{\text{Water.}}{3\left.\begin{matrix}H\\H\end{matrix}\right\}O.}$$

The lowest substitution-product from cotton, of those named above, appears to have the same composition as the substance which Braconnet first obtained in 1832, by dissolving starch in cold concentrated nitric acid, and adding water to the solution, when a white, highly combustible substance is precipitated, to which the name of *Xyloïdin* was given. The substitution-products from cotton, intermediate between the lowest and highest, are soluble in mixtures of ether and alcohol, and furnish by their solution the important material *collodion*, so invaluable in connection with photography, surgery, experimental electricity, &c.

According to Schönbein's original prescription, the cotton was to be saturated with a mixture of one part of nitric (of sp. gr. 1·5) and three parts of sulphuric acid (sp. gr. 1·85), and allowed to stand for one hour. In operating upon a small scale, the treatment of cotton with the acid for that period is quite sufficient to effect its complete conversion into the most explosive product *pyroxilin*, or *trinitrocellulose;* but when the quantity of cotton treated at one time is considerable, especially if it is not very loose and open, its complete conversion into pyroxilin is not effected with certainty unless it be allowed to remain in the acid for several hours. This accounts in great measure for the want of uniformity observed in the composition of gun-cotton and its effects as an explosive, in the earlier experiments instituted; and it is, moreover, very possible that the want of stability and, consequently, even some of the accidents which it was considered could only be ascribed to the spontaneous ignition of the material, might have been due to the comparatively unstable character of the lower products of substitution, some of which existed in the imperfectly-prepared gun-cotton.

The system of manufacture of gun-cotton elaborated by General von Lenk is founded upon that described by Schönbein; the improvements which the former has adopted all contribute importantly to the production of a thoroughly uniform and pure gun-cotton; there is only one step in his process which is certainly not essential, and about the possible utility of which chemical authorities are decidedly at variance with General von Lenk.

The following is an outline of the process of manufacture of gun-cotton as practised by Lenk. The cotton, in the form of loose yarn of different sizes, made up into hanks, is purified from certain foreign vegetable substances by treatment for a brief period with a weak solution of potashes, and subsequent washing. It is then suspended in a well-ventilated hot air chamber until all moisture has been expelled, when it is tranferred to air-tight boxes or jars, and at once removed to the dipping tank, or vessel where its saturation with the mixed acid is effected. The acids of the specific gravity prescribed by Schönbein are very intimately mixed in a suitable apparatus in the proportions originally indicated by that chemist, *i.e.*, three parts by weight of sulphuric acid to one of nitric acid. The mixture is always prepared some time before it is required, in order that it may become perfectly cool. The cotton is immersed in a bath of the mixed acids, one skein at a time, and stirred about for a few minutes, until it has become thoroughly saturated with the acids; it is then transferred to a shelf in this dipping trough, where it is allowed to drain and slightly pressed to remove any large excess of acid, and is afterwards placed in an earthenware jar provided with a tightly-fitting lid, which receives six or eight skeins, weighing from two to four ounces each. The cotton is tightly pressed down in the jar, and if there be not sufficient acid present just to cover the mass, a little more is added: the proportion of acid to be left in contact with the cotton being about ten and a-half pounds to one pound of the latter. The charged jars are set aside for forty-eight hours in a cool place, where, moreover, they are kept surrounded by water to prevent the occurrence of any elevation of temperature and consequent destructive action of the acids upon the gun-cotton. The same precaution is also taken with the dipping-trough, as considerable heat is generated during the first saturation of the cotton with the acids. At the expiration of forty-eight hours the gun-cotton is transferred from the jars to a centrifugal machine, by the aid of which the excess of acid is removed as perfectly as is possible by mechanical means, the gun-cotton being afterwards only slightly moist to the touch. The skeins are then immersed singly into water, and moved about briskly, so as to become completely saturated with it as quickly as possible. This result is best accomplished by plunging the skeins under a fall of water, so that they become at once thoroughly drenched. If they are simply thrown into water and allowed to remain at rest, the heat produced by the union of a portion of the free acids, with a little water would be so great as to establish at once a destructive action upon the gun-cotton by the acid present. The washing of the separate skeins is continued until no acidity can be detected in them by the taste; they are then arranged in frames or crates and immersed in a rapid stream of water, where they remain undisturbed for two or three weeks. They are afterwards washed by hand to free them from mechanical impurities derived from the stream, and are immersed for a short time in a dilute boiling solution of potashes. After this treatment, they are returned to the stream, where they again remain for several days. Upon their removal they are once more washed by hand, with soap if necessary; the pure gun-cotton then only requires drying by sufficient exposure to air at a temperature of about 27° C. to render it ready for use. A supplementary process is, however, adopted by General von Leuk, about the possible advantage or use of which his opinion is not shared by others, as already stated. This treatment consists in immersing the air-dried gun-cotton in a moderately strong, hot solution of soluble glass (silicate of potassa or soda) for a sufficient period to allow it to become completely impregnated, removing the excess of liquid by means of the centrifugal machine; thoroughly drying the gun-cotton thus "silicated," and finally washing it once more for some time until all alkali is abstracted. Lenk considers that by this treatment some silica becomes deposited within the fibres of the gun-cotton, which, on the one hand, assists in moderating the rapidity with which the material burns; and, on the other hand, exercises (in some not very evident manner) a preservative effect upon the gun-cotton, rendering it less prone to undergo even slight changes by keeping. The mineral matter contained in pure gun-cotton which has not been submitted to this particular treatment amounts to about 1 per cent. The proportions found in specimens which have been "silicated" in Austria and in this country, according to Lenk's directions, varies between 1·5 and 2 per cent. It is difficult to understand how the addition of 1 per cent. to the mineral matter, in the form chiefly of silicate of lime and magnesia (the bases being derived from the water used in the final washing) which are deposited upon and between the fibres in a pulverulent form, can influence to any material extent either the rate of combustion or the keeping qualities of the product obtained by Leuk's system of manufacture.

Gun-cotton, prepared according to the system just described, is exceedingly uniform in composition. The analyses of samples prepared both in Austria and at Waltham Abbey have furnished results corresponding accurately to those required by the formula—

$$C_6\left\{\begin{matrix}H\\ 3NO_2\end{matrix}\right\}O_5.$$

In its ordinary air-dry condition, it contains, very uniformly, about 2 per cent. of moisture—an amount which it absorbs again rapidly from the air when it has been dried. The proportion of water existing in the purified air-dried cotton, before conversion, is generally about 6 per cent. When pure gun-cotton is exposed to a very moist atmosphere or kept in a damp locality, it will absorb as much as from 6 to 7 per cent.; but if it be then exposed to air of average dryness, it very speedily parts with all but the 2 per cent. of moisture which it contains in its normal condition. It may be preserved in a damp or wet state apparently for an indefinite period without injury; for if afterwards dried by exposure to air, it exhibits no signs of change.

In these respects it possesses important advantages over gunpowder. The normal proportion of hygroscopic moisture in that substance varies three-quarters and one per cent.; but if exposed in any way to the influence of a moist atmosphere, it continues to absorb water until, however firm the grains may have originally been, it becomes quite pasty. It need scarcely be stated that when once gunpowder has become damp, it can no longer be restored to a serviceable condition, except by being again submitted to the processes of manufacture, starting almost from the commencement.

Perhaps the most vital considerations bearing upon the possibility of applying gun-cotton to important practical purposes, are those which relate to the risk likely to be incurred in its manufacture and preservation, in large quantities. The manufacture of gun-cotton is, unquestionably, much safer than that of gunpowder; in fact, there is no possibility of accident until the final drying process is reached, as, in all the other stages, the material is always wet, and therefore harmless. With the adoption of a proper system of warming and ventilation in the drying-chamber, the last operation is certainly not a more dangerous one than that of gunpowder. The question of the safe preservation of gun-cotton cannot, as yet, be so easily and satisfactorily disposed of. Specimens of gun-cotton exist which were prepared according to Schönbein's directions in 1846, and which have undergone no change whatever; on the other hand, it is well known that gun-cotton which was believed to have been perfectly purified, has become extremely acid, and has even undergone so complete a decomposition as to have become converted into oxalic acid and other organic products, when preserved in closed vessels, and especially when exposed continuously or occasionally to light. This susceptibility to chemical change has been particularly observed in samples of gun-cotton known to consist chiefly, or to contain some proportion, of the less explosive or lower substitution products (*i.e.*, gun-cotton specially prepared for the manufacture of collodion). Hence it is very possible that such instances as are considered to have been well authenticated, of the spontaneous ignition of gun-cotton when stored in considerable quantities, or during exposure to very moderate heat, may have arisen, not simply from an imperfect purification of the material, but also from the more or less imperfect conversion of cotton into the most explosive and apparently most stable product.

There is no doubt that the improvements effected in the system of manufacture of gun-cotton have been instrumental in rendering it far more stable in character than it was in the early days of its production upon a considerable scale. At the same time, although General von Lenk and its warmest partisans consider that its unchangeability can no longer be disputed, a greater amount of experience, combined with more searching investigations than have hitherto been instituted, upon the possibility of its undergoing change when under the influence of moderate heat, alone or combined with that of moisture, or when preserved under a variety of conditions, are unquestionably indispensable before its claims to perfect permanence can be considered as properly established. It has already been ascertained, by very recent experiments of the lecturer, that gun-cotton prepared and purified with the most scrupulous care speedily undergoes some amount of decomposition when exposed to temperatures ranging from 32° to 66° C.; it remains to be seen whether such decomposition, if once established by exposure of gun-cotton to some temperature within the above limit, will cease permanently when the material is removed from the influence of heat, or whether precautions or efficient supplementary processes can be adopted in the manufacture, to counteract the tendency to change exhibited by gun-cotton under the above circumstances. These are only some of the points which need patient investigation before it is positively known whether the requisite confidence can be placed in the material, as an agent susceptible of substitution for gunpowder.

It has been ingeniously argued that a slight indication of spontaneous change in gun-cotton need give rise to no alarm, because gunpowder is also liable to slight spontaneous change, reference being made to the fact that a very minute proportion of the sulphur in that material has been noticed to undergo oxidation. It need hardly be stated that such a minute change cannot have the slightest effect upon the stability of the mechanical mixture gunpowder, in which variations as regards purity and proportions of ingredients occur to an extent which render this change of absolute insignificance; whereas, in the case of gun-cotton, as now manufactured, the development of acid, however minute the proportion, may very possibly give rise to an important disturbance of chemical equilibrium in a compound, the stability of which is based upon the perfect uniformity of its composition; and it may also be at once productive of further change by the tendency which the acid itself has to exert chemical action upon certain elements of the gun-cotton.

The general properties of gun-cotton as an explosive agent have long been popularly known to be as follows:—When inflamed or raised to a temperature ranging between 137° and 150° C. it burns with a bright flash and large body of flame, unaccompanied by smoke, and leaves no appreciable residue. It is far more readily inflamed by powerful percussion than gunpowder; the compression of any particular portion of a mass of loose gun-cotton between rigid surfaces will prevent that part from burning when heat is applied. The products of combustion of gun-cotton in air redden litmus paper powerfully; they contain a considerable proportion of nitric oxide, and act rapidly and corrosively upon iron and gun-metal. The explosion of gun-cotton when in the loose, carded condition—the form in which it was always prepared in the early days of its discovery—resembles that of the fulminates in its violence and instantaneous character. In the open air it may be inflamed when in actual contact with gunpowder without igniting the latter; in a confined space, as in a shell or the barrel of a gun, the almost instantaneous rapidity of its explosion produces effects which are highly destructive as compared with those of gunpowder, while the projectile force exerted by it is comparatively small.

Professor of Chemistry to the Royal Academy.—The members of the Academy appointed to consider the Report of the Royal Commissioners have joined in the recommendation of a professorship of "chemistry as applicable to art." We have already advocated the appointment as most desirable, and hope the Academicians will soon give effect to the recommendation.

CHEMICAL SOCIETY.

Thursday, May 5, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the previous ordinary meeting having been read and confirmed, the following gentlemen were balloted for and duly elected Fellows of the Society—viz., Mr. T. S. Conysbee, engineer; Mr. Edward H. Prentice; M. Carl Schorlemmer, Owen's College, Manchester; and Mr. Edward F. Teschèmacher, Highbury Park.

The President then invited Sir Benjamin Brodie to favour the Society with a discourse entitled *"On the Organic Peroxides Theoretically Considered."* The lecturer then gave a most interesting and detailed account of his experiments upon the action of peroxide of barium upon the organic acids, and proceeded to enunciate the basis of his theoretical views regarding the constitution of these bodies. Numerous tables of formulæ were referred to in the course of the lecture, and many beautiful specimens of the chemical products in question were exhibited.

The author commenced by giving an historical sketch of the hypotheses of Dalton, Gerhardt, and several intermediate schemes which have from time to time prevailed. Most or all of these assume that the molecule of oxygen in water stands related to the hydrogen exactly in a similar manner as does chlorine to hydrogen in hydrochloric acid, and, consequently, that oxygen is the analogue of chlorine. The lecturer believed, however, that he should be able to demonstrate the error of this opinion, and was prepared to bring forward evidence to prove that peroxide of hydrogen, not oxygen, was the analogue of chlorine. Thus—

$$2HCl = H_2 + Cl_2,$$

and—

$$2H_2O = H_2 + H_2O_2.$$

In viewing the constitution of bodies framed on the ammonia type, it would be found that amidogen, H_2N, stands for chlorine; and in proceeding to classify the elements, it was known that chlorine, bromine, and iodine were alike, but that oxygen and sulphur constituted another group, and phosphorus and nitrogen a third. The new organic peroxides would, however, arrange themselves beside chlorine, &c., and exhibit many properties common to the elements of that group; for instance, they possessed powerful bleaching properties; were decomposed by light with evolution of oxygen gas; and their solutions immediately peroxidised the proto-salts of iron and manganese.

The preparation of the all-important agent—the peroxide of barium, Ba_2O_2—was then briefly described. By taking the ordinary crude product resulting from the passage of oxygen gas over heated baryta, a pure substance could be obtained by dissolving in cold dilute hydrochloric acid, and then adding to the solution baryta water until the precipitation was complete. The hydrated peroxide was thus thrown down in the form of lustrous crystalline plates, which should be well washed and dried. By the loss of water, the substance fell to a white powder, somewhat like magnesia in appearance; and in this form it was sometimes employed. The action of peroxide of barium upon anhydrous benzoic, succinic, lactic, and camphoric acids had been ascertained: all these gave rise to the production of organic peroxides, some of which had been already analysed. Glacial acetic acid, mixed with dry ether, furnished the peroxide of acetyl, which exhibited powerfully explosive properties.

In the preparation of peroxide of benzoyl, $C_{14}H_{10}O_4$, the anhydrous benzoic acid or the chloride of benzoyl might be employed. Equivalent proportions of the peroxide of barium, and either of these compounds, were rubbed together in a mortar, allowed to remain for some time in contact, then thrown upon a filter, and the chloride of barium, or other soluble salts, removed by washing with water. The product, after drying, could be crystallised by dissolving in bisulphide of carbon; and by the evaporation of this solvent the peroxide of benzoyl was obtained in beautiful large white crystals like sugar candy. It was necessary to attend strictly to the proportions; for if more than the prescribed amount of peroxide of barium be employed the yield is less, or the product is altogether decomposed, according to a secondary reaction, which was thus expressed:—

$$Bz_2O_2 + Ba_2O_2 = 2BaBzO + O_2.$$

No oxygen was evolved, nor benzoate of barium formed when the substances were carefully mixed in the ratio required by the formula—

$$2BzCl + Ba_2O_2 = 2BaCl + Bz_2O_2.$$

This peroxide is but slightly explosive as compared with the corresponding compound of acetyl. When boiled with solution of caustic potassa, oxygen gas was evolved, and an alkaline benzoate formed—

$$Bz_2O_2 + 2KHO = 2KBzO + O + H_2O.$$

The evolution of oxygen gas during the decomposition of an organic substance was alluded to as being a very unusual phenomenon.

By corresponding treatment of acetic acid with peroxide of barium a similar compound was formed. The author employed a mixture of glacial acetic acid and anhydrous ether, and digested for an hour or two with an equivalent proportion of the peroxide of barium gradually added, the temperature being kept low. At the end of this time it was filtered, and an etherial solution of the peroxide of acetyl passed through, which, on evaporation, furnished a viscid liquid capable of being crystallised by artificial cold. Some experiments with the etherial solution were then shown, and many of its leading properties thus demonstrated, particularly its power of bleaching indigo solution, of peroxidising the recently precipitated protoxide of manganese, and of liberating iodine from iodic acid. The action of light upon the peroxide of acetyl was remarkable, and so far as these experiments had proceeded, it appeared that the substance could be preserved without diminution of bulk in an open glass tube shielded from the light, but when exposed freely to sunshine the substance was decomposed, with liberation of oxygen gas, and returned to acetic acid, which then gradually evaporated. Here, again, might be traced a parallel between the results of the action of light upon the organic peroxides and the aqueous solution of chlorine. Potassa behaved also in a similar manner, oxygen being eliminated, and a salt of the alkali formed. The violently explosive character of the peroxide of acetyl rendered it necessary to exercise the greatest caution in its preparation. It was whilst being engaged in the production of a small quantity of the pure substance for analysis that Professor Brodie met with the accident which prevented his attending the meeting of the Society originally appointed for the delivery of this lecture. He had obtained about thirty drops of the peroxide of acetyl by the distillation of a quantity of the etherial solution, and was proceeding to dry the same by the gradual addition of fused chloride of calcium, when, upon dropping into the retort the eighth or tenth piece, the whole of the product suddenly exploded, and, of course, shattered the glass apparatus in which it was contained. The same property in a minor degree was exhibited by the peroxide of benzoyl; a small quantity of this substance was then heated in a test tube, when it detonated slightly. Under these circumstances, the lecturer found that about half the constituent carbon escaped as carbonic anhydride, the rest being occupied in the formation of two or three resinous bodies, which had not yet been examined.

The second division of the subject comprehended an account of the peroxides of radicals of the diatomic acids. Under this head much less was known, but the author had prepared the peroxides corresponding to succinic, camphoric, and lactic acids, of which he had partially made the analyses, and ascertained that their general properties were bleaching and oxidising. From anhydrous camphoric acid, $C_{10}H_{14}O_3$, the author had succeeded in preparing the barium salt of an anhydrous bibasic radical. Its formula was $C_{10}H_{14}O_5Ba_2$.

Succinic acid gave a similar barium compound, which was soluble in water, and when the solution was heated it gave off oxygen, and furnished a white precipitate of the ordinary succinate of barium. The peroxide of succinyl was so rapidly changed that it had not yet been obtained in a pure state. Bodies of this class were distinguished by their power of effecting the peroxidation of the hydrated protoxide of manganese, but they did not evolve oxygen from chromic and manganic acids. It would be evident from the foregoing statement that the organic peroxides would arrange themselves into two groups, viz., the monatomic and the diatomic analogues of chlorine. This difference might be symbolised by the equations—

$$1.\ C_2H_6 + Cl_2 = 2CH_3Cl.$$
$$2.\ C_2H_4 + Cl_2 = C_2H_4Cl_2.$$

From the preceding investigation the author considered himself justified in announcing the existence of a group of chemical substances, which comport themselves exactly like chlorine, and are constituted of organic radicals in association with a maximum of oxygen. These facts lent support to the binary theory of salts as originally proposed by Dulong, and established by the later experiments of Daniell and Miller; and, taken in conjunction with the theory of radicals as advocated by Laurent and Gerhardt, Williamson, Kekulé, and others, offered a complete and satisfactory explanation of many hitherto doubtful chemical reactions. Reference was made, in conclusion, to the disappearance of oxygen at the positive pole during the electrolysis of water and of dilute sulphuric acid. Maidinger had shown that when sulphuric acid of the gravity 1·3 was decomposed by the battery a very notable diminution in the proportion of oxygen was observed, and that the liquid acquired the property of separating iodine from hydriodic acid. He had attributed this result to the production in the liquid of the peroxide of hydrogen, but the lecturer considered it more probable from the chromic acid reaction that a sulphur acid higher in the series than sulphuric acid was generated, and that the formation of persulphuric acid, H_2SO_5, would hereafter be substantiated. It was, however, necessary to admit at once the policy of framing a new group of radicals, which, although compound, were to be treated of exactly in the same manner as chlorine. This analogy to chlorine suggested many promising lines of research; thus, Are the organic peroxides capable of uniting with olefiant gas and with carbonic oxide? And will it be possible to form substitution compounds in which these new bodies will replace hydrogen?

The PRESIDENT rose to offer in the name of the Society a vote of thanks to Professor Brodie for the masterly discourse with which he had favoured them. The interest which attaches to the substances described, which are both compounds of radicals and radicals in themselves, is such that the whole subject deserves to be written in golden letters in the annals of the Society. He wished to ask the lecturer whether he found it possible to "lock up" two molecules into one compound radical?

Professor A. W. HOFMANN had listened with great pleasure not only to that portion of the discourse which treated of a rich variety of chemical reactions, but particularly to the lecturer's remarks wherein he sketched out the future of his discoveries. For his own part, he was anxious to hear some account of the parallelism between chlorine and the organic peroxides with regard to their action on ammonia.

Professor WANKLYN referred to the artificial production of glycol by the direct action of peroxide of hydrogen upon ethylene, as announced by Carius, as having already realised one of the speculations entertained by the lecturer.

Mr. SMEE and Sir ROBERT KANE offered some remarks in confirmation of the binary theory of salts, and the support to be gathered from the law of electrolysis, certain technical points in the voltaic deposition of copper being likewise referred to.

Dr. W. A. MILLER considered that the simple view of electrolytic decomposition which was sometimes advocated was untrue in a great number of instances. There were often several products—not two only—formed simultaneously, and the results were then more complicated than had been represented.

Sir BENJAMIN BRODIE, in reply, stated that he had endeavoured to prepare organic peroxides containing two radicals or molecules—thus benzoyl and acetyl had been tried in admixture—but he had not yet succeeded in associating them or any other members of distinct series. Respecting the production of glycol through the intervention of peroxide of hydrogen, he did not consider that there were sufficient grounds for believing that this had really been accomplished. The experiments alluded to by Professor Wanklyn did not appear to be sufficiently specific. The term "peroxide of hydrogen" was always applied to a solution of that substance in water, but he hoped the day was not far distant when the pure peroxide, H_2O_2, would be isolated. The action of ammonia upon peroxide of benzoyl had been partially investigated. The products were benzoic acid, benzamide, and nitrogen, but there appeared to be other bodies formed which could not yet be defined.

The meeting was then adjourned by the President until the 19th instant, and the titles of several papers were announced.

Thursday, May 19, 1864.

The minutes of the previous meeting having been read and confirmed,

The PRESIDENT announced that steps had been taken by the Council for the purpose of aiding the subscription towards the erection of a memorial to Sir Humphry Davy in Penzance. It had been resolved to appoint Mr. West collector, and any funds placed in his hands would be in due course forwarded in the name of the Society to the Cornwall Committee.

Mr. Conysbee was formally admitted a Fellow of the Society; and Dr. Wrightson, of Birmingham, and Mr. Manning Prentice, of University College, London, were duly elected by ballot.

The PRESIDENT had much pleasure in announcing that among the visitors with whom they were favoured on the present occasion was Dr. De Vrij, who had lately returned from Java.

A paper "*On the Constitution of Wood Spirit,*" by Mr. William Dancer, of Manchester, Dalton Scholar, was read by the SECRETARY. The author had, upon the recommendation of Professor Roscoe, undertaken the chemical examination of crude wood spirit, and had been led by his experiments to the conclusion that four different substances in admixture made up the bulk of the rough commercial product. The separation of these was conducted in the following manner:—The crude spirit was treated with chloride of calcium and submitted to fractional distillation, or a larger quantity of the wood spirit was dried over quick-lime, and then distilled from hydrate of soda, whereby the acetate of methyl was decomposed. The acetone was then separated by digesting with bisulphide of soda, and the residual liquor distilled from fused potassa. After employing chloride of calcium to unite with the methylic alcohol, a liquid passed over between the temperatures of 55° and 70° C, upon which sodium had no action. This product was found to be bimethylacetal, having the boiling point 63-64° C, and vapour density equal to 3·165; calculation demanding the number 3·114. Its specific gravity at zero Centigrade was 0·8787, as compared with water at its maximum density, viz., at 4° C. All its properties agreed with those described by

Wurtz as appertaining to the product of the action of binoxide of manganese and sulphuric acid upon a mixture of ethylic and methylic alcohols. The quantity of bimethyl-acetal found in two litres of ordinary wood spirit varied in different samples from 10 to 20 grammes. The author concluded by summing up the constituents of crude wood naphtha, and stated that besides the great bulk of methylic alcohol there were present acetate of methyl, acetone, and bimethyl-acetal, but he ignored altogether the existence in this product of the substance hitherto described under the name of xylyl.

The next communication, by Dr. J. H. Gladstone and Mr. Holmes, "*On the Chloro-phosphide of Nitrogen, and on two new Acids related thereto,*" was read by Dr. Odling. The authors refer to a previous publication on the same subject by Dr. Gladstone alone in the third volume of the Society's *Quarterly Journal*, wherein it was stated that the chloro-phosphide had the formula $P_3N_2Cl_5$. Laurent, in 1850, questioned the accuracy of this expression from considerations of a theoretical nature, and the authors were now prepared to admit as the correct formula that proposed by the eminent French chemist, viz.:—$P_3N_3Cl_6$. This substance was produced by the action of ammonia upon pentachloride of phosphorus, but the simplest expression in the form of an equation did not by any means represent the changes actually occurring. The two acids were named respectively azo-phosphoric and deutazo-phosphoric, and one of the most striking peculiarities of the latter was that the ferric salt was soluble in ammonia. Deutazo-phosphoric acid was produced by the action of dry ammonia gas on the oxychloride of phosphorus (Wurtz), and was soluble in water, and from the copper or iron salt by the effect of heat the azo-phosphoric acid was formed. The deutazo-phosphate of iron $Fe_2P_2NH_4O_7$, was very soluble and hygroscopic, and the zinc, copper, and barium salts had been prepared and examined. The analysis of the azophosphate of silver led to the formula—$Ag_2P_2N_2H_4O_5$. The names "pyrophosphamic acid" and "pyrophosphordiamic acid" had been proposed for these compounds, but were not generally adopted.

The President considered there was no reason to hesitate in writing the equation explanatory of the production of the chlorophosphide of nitrogen as follows:—

$$3NH_3+3PCl_5=9HCl+P_3N_3Cl_6.$$

Mr. Holmes stated that the amount of the product was so small that this equation could not truly express the change; there appeared to be secondary products which engaged some of the phosphorus.

At this stage of the proceedings the President vacated the chair, which was then occupied during the remainder of a long evening by Mr. Warington, and the following papers were read, viz.:—"*On a New Method of Gas Analysis,*" by the President and Dr. Russell; and the President afterwards favoured the Society with some remarks "*On the Classification of the Elements according to their Atomic Weights.*" An abstract of these communications must, from want of space, be deferred until next week.

ACADEMY OF SCIENCES.

May 16.

M. Boussingault communicated the first part of a memoir "*On Vegetation in Darkness.*" The author brings forward several experiments which prove that the growth of a plant in the dark is supported entirely at the expense of the seed. We give the results of one experiment, made with grains of wheat or maize sown in moistened sand, and kept quite in the dark:—

Weight of seed . .	0·926 milligrammes.
Weight of plant grown	0·566 „
Loss of weight .	0·360 „

Another grain was sown in the same soil, but exposed to light. In this instance the results were as follows:—

Weight of seed . .	0·922 milligrammes.
Weight of plant .	0·293 „
Gain of weight .	0·371 „

It is interesting also to compare the gain or loss of carbon, oxygen, and hydrogen in these two cases:—

	In the light.		In the dark.
Carbon acquired .	0·1926	lost	0·1598
Hydrogen acquired .	0·0200	„	0·0232
Oxygen acquired .	0·1591	„	0·1766

Thus it is seen that under the influence of air and moisture, in a soil deprived of manure, a plant in the light assimilates carbon, and, at the same time, fixes hydrogen and oxygen in the proportions to form water. In the dark, on the contrary, carbon is eliminated, and so are hydrogen and oxygen also in the proportions to form water.

A note, by M. Lemoine, "*On the Action of Red Phosphorus on Sulphur,*" gives an account of some compounds of the two elements. The author found that when these two bodies reacted on each other they produced a compound having the formula P_2S_3. This compound is invariably produced, whatever the proportions employed may be. It is a very stable body, not oxidising in the air, which crystallises in the right rhombic prismatic system, boils and distils between 300° and 400° C., and dissolves in sulphide of carbon and chloride of phosphorus, from which latter solution water separates it unaltered. Alcohol and ether dissolve, but, at the same time, decompose it. It is perfectly soluble in the sulphides of potassium and sodium. Caustic potash dissolves it even in the cold, disengaging a mixture of hydrogen and phosphuretted hydrogen. Assisted by heat, the reaction produces sulphide of potassium and phosphite of potash. We ought to say that the author produced the compound by heating the two constituents together, and then separated it by means of sulphide of carbon, in which, as we have said, it easily dissolves.

M. Wurtz contributed the second part of an elaborate paper "*On the Diallylic Compounds.*" The author states, as the results of his researches, that there exist two series of diallylic compounds. The radical diallyl may combine with one or with two molecules of hydriodic acid, and form also corresponding acetates and hydrates. The two series are double, and just as the compounds of the diatomic series of diallyl are isomeric with the hexylic compounds, so, in the mono-atomic series, there appears to exist two isomeric hydrates.

M. Hardy presented a note "*On the Decomposition of Uric Acid by Bromine, and the Action of Heat on Alloxan.*" Bromine gives no substitution products with uric acid, but in the presence of water splits it up into alloxan and urea, forming, at the same time, hydrobromic acid. If the temperature be high, more complex changes take place, and parabanic and oxalic acids are formed, with some hydrobromate of ammonia. Chlorine and iodine give results similar to those with bromine. Alloxan heated to 150° loses two atoms of water; if the heat be carried to 250° it loses no more water, but acquires the property of giving coloured solutions. When treated with a base this modified alloxan fixes two atoms of water, and forms an acid identical in composition with alloxanic acid, but which gives coloured salts. The author proposes to call this *Isoalloxanic Acid.* The author believes that the purple compound produced in the well-known nitric acid and ammonia test for uric acid is not murexide, but isoalloxanate of ammonia.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"Discrimination of Organic Bodies by their Optical Properties," by Prof. Stokes.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

937. Thomas Steven, Glasgow, and Charles Batty, London, "Improvements in arrangements and apparatus for ventilating, for protecting from heat, and for heating and cooking."—Petition recorded April 14, 1864.

993. D'Herman Lomer, Brussels, Belgium, "Obtaining colouring matter as substitute for aniline colours."—Petition recorded April 21, 1864.

1071. George Schaub, New Hanley Road West, Upper Holloway, Middlesex, "An improved mode of transmitting currents of electricity for telegraphic purposes."

1072. Thomas Goulston Ghislin, Hatton Garden, London, "Improvements in the treatment and application of sea-weed."—Petitions recorded April 28, 1864.

1073. Marc Antoine François Mennons, Westminster, "An improved apparatus for the capsulation of fluid medicines."—A communication from Jules Viel, Tours, France.

1076. Richard Hudson Smithett, Inner Temple, and John Davidson, Temple Street, Blackfriars, "Improvements in treating clay, artificial stone, metal, or other plastic or malleable material, to render it more suitable for constructive purposes."

1077. John Davidson, Temple Street, Blackfriars, "Improvements in the manufacture of bricks or blocks for use in the formation of arches from clay, artificial stone, or other similar plastic materials, and in the apparatus used in such manufacture."

1081. Richard Archibald Brooman, Fleet Street, London, "A new method of treating wood and other ligneous substances in order to produce alcohol and to obtain the cellular tissue or fibre from such substances applicable to the manufacture of paper and other uses."—A communication from François Marie Bachet and Etienne Machard, Annecy, France.

1082. John M'Call, Houndsditch, London, and Bevan George Sloper, Walthamstow, Essex, "Improvements in preparing and preserving food."

1087. Frank Clarke Hills, Deptford, Kent, "Improvements in and applicable to furnaces to be used in the manufacture of gas."

1088. Frank Clarke Hills, Deptford, Kent, "Improvements in the purification of gas, and in obtaining a valuable product in the process, and for the preparation of some of the materials to be used in the said purification."—Petitions recorded April 29, 1864.

1095. Richard Archibald Brooman, Fleet Street, London, "Improvements in tanning." A communication from Barthelemy Picard, Puteaux, France.

1100. James Lee Norton, Belle Sauvage Yard, Ludgate Hill, London, Francis Gregory and James Salmon, Manchester, Lancashire, "Improvements in presses and apparatus connected therewith, and in pressing fats, seeds, shoddy, cotton waste, tobacco, and paper."—Petitions recorded April 30, 1864.

1107. Peter Armand Lecomte de Fontainemoreau, Rue de la Fidélité, Paris, France, "Certain improvements in apparatus for washing ores and other substances, and in separating earth and other impurities adhering to them." A communication from Jean Emile Austruy, Paris, France.—Petition recorded May 2, 1864.

1111. Alfred Watson Gittens, Hull, Yorkshire, "An improved method of finishing photographic pictures and marbled papers, and improvements in pressing rolls employed therein, and applicable to other pressing rolls."

118. William Smith, Lower Bagot Street, Dublin, "Improvements in the manufacture of artificial fuel."—Petitions recorded May 3, 1864.

1119. Edward Beanes, Argyll Street, London, "Improvements in the treating of animal charcoal."

1121. Benjamin Hammerton, Bolton, Lancashire, "Improvements in miners' safety lamps."

1123. William M'Vitie, Glasgow, N.B., "Improved arrangements for inducing the circulation of a liquid for condensing or refrigerating."

1125. Thomas Henry Rees, Dennett Road, Hatcham, Surrey, "Improvements in blue colouring matters for washing purposes, and in receptacles for containing the same ready for use."

1128. John Thompson, Hilldrop Crescent, Camden Road, "Improvements in apparatus for securing stoppers for bottles."—Petitions recorded May 4, 1864.

1161. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improved apparatus for facilitating the inhalation of medicinal substances."—A communication from John Jones, New York, U.S.—Petition recorded May 7, 1864.

1173. Francis Herbert Wenham, Union Road, Clapham, Surrey, "Improvements in motive power engines worked by explosive mixtures of gas or vapour." — Petition recorded May 9, 1864.

1187. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels."—Petition recorded May 10, 1864.

Notices to Proceed.

30. Joseph Judge Hays, Hitchin, Hertford, "Improvements in the manufacture of peat charcoal, and in the apparatus employed therein."—Petition recorded January 5, 1864.

101. William Jeremiah Murphy, Cork, Ireland, "An improved steam-brewing copper."

106. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels, which improvements are also applicable to stopping the muzzles of firearms."—Petitions recorded January 14, 1864.

109. John Edward Baker, Birmingham, Warwick, "Improvements in retorts and furnaces for distilling coal and peat, and other solid hydrocarbons, for the manufacture of volatile oils therefrom, which improvements may also be applied to retorts and furnaces used for other purposes."—Petition recorded January 15, 1864.

195. Robert Alfred Wright, Pentonville Road, Middlesex, and Ernest Wright, Nelson Square, Surrey, "Improvements in apparatus for consuming smoke and promoting the combustion of fuel in furnaces."—Petition recorded January 23, 1864.

332. James Webster, Lee Crescent, Birmingham, Warwick, "Improvements in the preparation of paints or varnishes."—Petition recorded February 8, 1864.

335. John Clutton Blair Salt, Birmingham, Warwick, "Improvements in protecting iron ships and vessels from corrosion."—Petition recorded February 9, 1864.

436. William Charles Page, Millwall, Poplar, Middlesex, "An improved composition for coating ships' bottoms."—Petition recorded February 19, 1864.

952. Charles Doughty and William Drake Key, Lincoln, "Improvements in treating a product obtained in refining the oil of cottonseeds."—Petitions recorded April 15, 1864.

Honorary Degrees at Cambridge.—Of all the honorary degrees to be conferred at the approaching Royal visit to the University of Cambridge, none, it must be confessed, will be more worthily bestowed than those on Dr. Hofmann and Professor Wheatstone.

Royal Institution.—Tuesday, May 31, at three o'clock. Professor Marshall, "On Animal Life." Thursday, June 2, at three o'clock, J. Hullah, Esq., "On Music (1600—1750)." Friday, June 3, at eight o'clock, Professor Frankland. Saturday, June 4, at three o'clock, Alexander S. Herschel, Esq., "On Falling Stars."

CORRESPONDENCE.

Hicks' Standard Barometer.

To the Editor of the Chemical News.

Sir,—It is no doubt generally believed that papers received and published by the Royal Society are subjected to a more rigid scrutiny than is usually adopted in the other so-called learned societies. Although probably the responsibility is supposed to rest with the author of the paper, yet still by this supposed greater care in accepting papers the Royal Society assumes a greater amount of this responsibility, and at least gives the sanction of its authority to the paper as a new and, more or less, a valuable contribution to science. In the proceedings for this year, page 169, is published a description of a standard barometer, which, from the way it is introduced, would be accepted by the readers as quite new and original. In connection with this subject, I beg leave to draw your attention to the following quotation—not from some obscure contribution to science buried under the great accumulation of learned and unlearned lore which the press is continually pouring forth in such an abundance that the admirable Crichton himself would be baffled in attempting to master it all, but from a work supposed to be in every scientific library—the *Encyclopædia Brittanica*, seventh edition, 1842, vol. iv., page 391, and again appearing, probably from the same stereotype plates, in the eighth edition: the writer is Sir J. Leslie:—

"The most accurate construction of a barometer of this kind [the conical barometer invented by Amontous in 1695] is attained by joining two tubes that have even, but unequal, bores, the longer and narrower being uppermost. If the width of the upper tube were supposed to be to that of the under one as two to three, the scale would be enlarged three times, since by descending three inches from the top, and consequently two at the bottom, the column would suffer a contraction of one inch in height. This species of barometer is thus recommended by its simplicity and its ample range. But the bore of the tube being indispensably small, the mercury moves with difficulty, and resists the impression of minute changes of external action."

I could mention the names of persons in London and elsewhere who have made such instruments long since; but the defect here alluded to has no doubt prevented any very general adoption of this form of barometer; and it can only be removed by Whiting's plan, as shown by Mr. Becker in the *soirée* of the Royal Society last year—viz., by using a larger tube and a moveable piston at the bottom. But there appear to be practical difficulties attending this form also. Mr. Becker told me, and no doubt others, that Whiting had also constructed instruments as above described. Most persons familiar with the instrument will, I think, from the defect alluded to by Sir J. Leslie, still doubt the applicability of this form of instrument as a standard barometer, at least until proved by actual work. But the following extract from the same work (page 400) and by the same author will show that the plan of adapting a scale of inches to it is more than twenty years old:—

"A modification of the conical barometer, in travelling, we have ourselves employed. The principal part consists of a small steel stop-cock; a glass tube, 31 or 32 inches long, with a bore of the tenth of an inch, sealed at the top and filled with quicksilver, is cemented into one end of the stop-cock, and into the other end is cemented an open and wider tube, 16 inches or more in length, and having its diameter above the eighth of an inch. This compound tube is lodged in a walking stick divided into inches and tenths through its whole extent, or only at the upper part."

It is true there is no mention of verniers here, but seeing that scarcely any barometer sold is without verniers, the addition of these seems hardly sufficient to warrant recording their adoption as among the scientific discoveries and inventions of the year. It may be confidently asserted that if any competent maker received an order for a barometer to be made from Sir J. Leslie's description, he would have made it with verniers, and most probably have divided it exactly as the instrument described in the *Proceedings* of the Royal Society, without thinking for a moment that he was making a new instrument.

It may be considered quite allowable in the way of trade for a maker to introduce an instrument little known, and if the trade accept it as such, to sell it with his own name attached to it, and it would be very foolish for him not to avail himself of any honourable and straightforward means of introducing his instruments and his name to public notice, but it was hardly to be anticipated that the Royal Society would stamp with its authority claims which can thus be so completely set aside by extracts from so popular a work; and as no doubt the *Proceedings* of the Royal Society would be generally considered authoritative in matters connected with the history of science, perhaps you will consider these observations worth recording in your columns. It may be mentioned that this barometer as first described without the scale of inches appears in the "*Journal of the Society of Arts*" for the 1st of April! as a newly-invented instrument.

I am, &c. W. Symons.

17, St. Mark's Crescent, Regent's Park, May 19.

MISCELLANEOUS.

YOUNG v. FERNIE.

(Continued from page 252.)

Dr. Hofmann's evidence continued: I have read the extracts from the works of Morand. ["The Art of Working Coal Mines." By M. Morand. First part—"Coal and Coal Mines." Paris: 1768. Second part—"Theoretical and Practical Essay on the Different Applications of Coal for Manufactories, Factories, and Domestic Use." Paris: 1777. This work contains a description of Genssane's method by which bitumen was obtained from coal by a downward distillation. The apparatus employed appears to have been a clay retort which when filled with coal was closed; at the bottom of the retort was a gutter, and only one outlet supplied with a long copper pipe inclined downwards; this pipe communicated with a cast-iron vessel to receive the bitumen flowing out. Another copper pipe rising vertically was fixed to the descending pipe, and served for the evaporation of the 'sulphur vapours.' The retort was heated until it became slightly red, and at that degree of heat the bitumen was said to flow into the receiver. The bitumen is described as very greasy, and suited for greasing carriage wheels. The oil is said to differ from petroleum in being less inflammable.] If I understand this process correctly, it is a process for fusing out bituminous constituents rather than distilling them; the oil collects in the bottom of the retort and flows out; it is not volatilised in this case. It must exist in a state of vapour before it collects. The heat is described as a light red; it is not the same expression, but it may be taken as the same as that described by Mr. Young. I am not prepared to say that it would be the same oil. Supposing the same coal to be used, I admit that you would obtain an oil somewhat similar. [An extract from the 'Encyclopédie Methodique (Paris and Liège, 1782,) describing the same works was now referred to.] The method is now referred to as one for "desulphurising coal;" in this process an oil is incidentally produced. It would appear to be same as that of Genssane [the last referred to]. [An extract from a book by M. Sage, "Observations sur la Physique," was now produced and read as follows:—The peculiar characters of cannel coal are due to the quantity of bituminous oil that it contains. This cannel coal yields by distillation one-third of its weight oil. Newcastle coals contain nearly as much bitumen as cannel coal.] This is a general statement, such as you find in chemical works generally. There are different qualities of coal which yield different quantities of oil. I have heard of M. Selligue's process. [The account of it is given in the Jury Report on the exhibition of French industrial products in 1839. The oil is distilled from schist, and on redistilling the crude oils, they are separated into a drying oil, an oil suitable for burning in special lamps, a bituminous residue, a lubricating substance, and lastly, paraffine.] I saw candles made by Selligue in the London Exhibition of 1851. The substances obtained by Selligue, with the exception of the paraffine, are so ill defined that I could give no opinion upon them. The crude oil, from which the drying and the burning oil, &c., are obtained, would probably be produced from schist at the range of temperature described by Mr. Young. I have never seen the French schist, but I have obtained by distilling Dorsetshire shale products, especially paraffine, which inclines me to believe that a temperature of a low red heat would probably yield analogous products. I know Lord Dundonald's specification. [It is dated 1781, "for making tar, pitch, gas, &c., from coals." The following extract from the specification will give our readers an idea of the process. It is declared that "persons who shall extract tar, pitch, essential oils, volatile alkalies, mineral acids and salts, from pit coals in vessels or buildings (it matters not their shape or size), whereby the coals are made to burn or ignite without flaming by a regulated admission of the external air through different apertures in the buildings, so as by their own heat to throw off the tar, oils, &c., that they contain; persons who do so without permission are deemed to encroach upon my patent; as the only method known or used until my new discovery was distillation of coal in close vessels, where the admission of external air was prevented."] It is evident with this patent that you must employ a high temperature, for the object is to obtain pitch and coke. There is an extension of the patent. The pitch is produced in the first operation, but is obtained in a subsequent process by the separation of the more volatile from the less volatile products. I have said that the great principle of Mr. Young's invention is the use of a graduated and moderate temperature and the selection of proper coal. ["Ure's Dictionary," edition 1821, was now referred to. The extract read was the following:—"If coal be put into a cold retort and slowly exposed to heat its bitumen is merely volatilised in the state of condensible tar; little gas, and that of inferior illuminating power, is produced. This distillatory temperature may be esteemed at 600° or 700° F. If the retort be previously brought to a cherry-red heat, then the coals, the instant after their introduction, yield a copious supply of good gas, and a moderate quantity of tarry and ammoniacal vapour."] This passage refers chiefly to the manufacture of gas, and appears to say that if the heat be very strong a gas is obtained of inferior illuminating power; and that if it be very low you obtain little or no gas, but substances which he describes as bitumen or condensible tar. He states the temperature to be 600° or 700° F. I do not believe the coals Mr. Young employs in his operations give off any bitumen or condensible tar at 600° or 700° F. If this bitumen is given off at 600° or 700° F., the kind of coal used must be essentially different from that Mr. Young employs. Dr. Ure speaks of gas coal, but of a kind of coal which yields volatile matter at 600° or 700° F. I think there is some discrepancy in the temperature. I gave the range of temperature [of a low red heat] from 800° to 1000°, but one man may take it as little more than 800° and another near to 1000°. The general belief now is that it is nearer to 1000° than 800°. Dr. Ure, in his book, gave it as 812°. [The next extract referred to was from a paper by Dr. Henry in the "Annals of Philosophy," 1819. It was as follows:—"The temperature to which coal is subjected must necessarily be a point of the greatest importance to the quantity and quality of the aeriform products; for, while too low a point distils over, in the form of a condensible fluid, the bituminous part of the coal which ought to afford gas, too high a temperature, on the contrary, occasions the production of a large relative proportion of the lighter and low combustible gases. With the view of ascertaining how low a degree of heat is adequate to the production of gas from coal, I placed a small iron retort . . . about the fusing-point of lead . . . a dull red or blood-coloured heat. This temperature I suspect is rather too low, and has a tendency to distil over too much tar."] This statement appears incompatible. The author speaks of the fusing-point of lead, and calls it a dull red or blood-coloured heat. At about the fusing point of lead you could not possibly obtain a dull red or blood-coloured heat. [It is right to say that the extract, as read by the Attotney-General, is garbled. Dr. Henry does not speak of the fusing of lead as a dull red or blood-coloured heat. It was a separate experiment, in which a Wedgwood pyrometer was used to indicate the temperature]. Dumas' "Chemistry Applied to the Arts" (1828) was next quoted. "Coal exposed to a bright red heat in a close retort is rapidly decomposed, yielding coke, tar or oil, water and gas. The relative quantities of each of these substances differ not only according to the varieties of the coal, but of the temperature. Experience has shown that the quantity of oil or tar, as well as that of coke, is greater when the temperature is low. The proportion of gas, on the contrary, is greater at a high temperature; that is to say, more gas is obtained the less oil is produced. In making illuminating gas, the retorts are in the first place brought to a cherry-red heat."] In this passage there is a general statement of the necessity, in the manufacture of gas, of a high temperature. Cherry-red, I would say, is a good red—a bright red heat. [Kane's "Elements of Chemistry" (1841) was next quoted from. The author having mentioned fossil wax and rock oil, &c., proceeds:—"The products of the distillation of coal in close vessels possess a remarkable analogy to those that have been now described. . . . . . The liquid products consist of various bodies closely analogous to petroleum, and the solids consist of naphthaline and paraffine. The relative proportions of these products vary with the temperature. The lower the heat employed the less gas and the more solids and liquids are produced.] The liquid products may or may not correspond to the crude oil of Mr. Young according to the nature of the coals and the temperature. Kane says that to get those liquid products analogous to petroleum you should employ a lower heat; but it is not so with regard to solids. The temperature for naphthaline should be high, and for paraffine low.

Re-examined by Mr. Bovill: We need not give the re-examination at great length. The papers of Reichenbach were first referred to, and in answer to the question whether these papers are of any practical value in procuring paraffine as a commercial article, Dr. Hofmann stated that the papers were essentially of a scientific nature. Reichenbach certainly had a commercial article in view, but he did not get it; Mr. Young did succeed. The statement that paraffine is a product of the carbonisation of all organic substances is a mistranslation. The correct translation is that paraffine is a product of the carbonisation of animal tar, vegetable tar, and pit coal tar. Reichenbach's experiments on the distillation of coal were laboratory experiments. He states that he always obtained eupion, picamar, creosote, paraffine, moder, sulphur, &c. I have never seen picamar; I cannot say whether it is present in Mr. Young's oils; I do not think that moder or sulphur is present; I do not know whether creosote is present or not. Eupion may or may not be present; but the properties of eupion given by Reichenbach do not correspond with those belonging to Mr. Young's oil. With regard to the various specifications referred to in the cross-examination, not one informs the public how they could practically make paraffine for commercial purposes from bituminous coal, or discloses Mr. Young's process. Nothing that had been done with shale would enable a person to know with certainty that he could produce a similar effect with bituminous coals without experiments. Mr. Young's general description of coals would be well understood. Boghead would, according to my belief, be properly called a cannel coal. Coal is not a definite chemical compound; it is difficult to trace the line of demarcation between coal and stone. I could not tell the properties of a coal from mere inspection or by scratching with a knife. I could not do so at all without I had an opportunity of making a chemical examination of it. I never heard boghead cannel called schist until the trial of Gillespie *v.* Russell. [The celebrated Torbane-hill mineral case. The question whether boghead was a coal or a schist was not decided at the trial. The scientific evidence was pretty equally balanced on the question.] In my judgment boghead mineral is a different thing from shale. I distilled shale, to ascertain whether similar results could be obtained from it, in 1857. I obtained very little paraffine from it, and the oils had a nauseous odour; they had to be submitted to a succession of chemical operations to deprive them of their odour. In Genssane's process, described by Morand, coals are said to lose one-eighth of their weight, in Mr. Young's process as much as 50 per cent. is volatilised. According to my belief, Genssane's plan is not a practical mode of making Mr. Young's oil. A great deal of the oil if it were produced would be lost, being carried off by the perpendicular tube which communicates with the atmosphere, and which is placed just at the point where the products emerge from the furnace. Du Buisson's is a process of distillation like Mr. Young's, but he makes use of bituminous schistus, clay slate, &c. The heat employed, it is said, must not exceed a cherry red, which is very different to a low red heat. The materials differ, and the process differs from Mr. Young's. Du Buisson states of his oil that it saponifies very well, and appears to derive a great part of its properties from the presence of paraffine. Mr. Young's oil will not saponify. I have never made the experiment, but I know from the nature of the substances that it will not. Du Buisson's statement that paraffine is contained in the largest proportion in schistus would mislead a person with respect to bituminous coals. Experiments would refute Du Buisson's opinion. No person from reading his specification would be aware that paraffine could be obtained from bituminous coals. [A question was here asked about the composition of paraffine and paraffine oil, and at the request of the Vice-Chancellor, Dr. Hofmann went into the chemistry of the matter. We give an abridgment of his statement.] When paraffine was first examined, it was said to have the same composition as olefiant gas, but this was subsequently denied by Lewy, who stated that he found for one part of hydrogen 5·95 parts of carbon. The subject was pursued in this country by Professor Anderson, Sir Benjamin Brodie, and others. Professor Anderson examined two varieties of paraffine, one from Boghead cannel and another from Rangoon tar. Lewy's experiments were made with paraffine obtained by the distillation of wax. Professor Anderson found that paraffine is not an individual compound, but a mixture of several compounds. Amongst these he admits the existence of one having the same composition as olefiant gas, and another having the composition given by Lewy; he adds that there are probably several in which one part of hydrogen is contained with 5·95—5·96 of carbon. Sir B. Brodie's experiments led him to the conclusion that paraffine had the same composition as olefiant gas, and I believe he is correct. The liquids are not a pure chemical substance, but a mixture of substances. In fact, paraffine oil boils between 300° and 500°. A pure chemical substance boils at a fixed temperature. Water, for instance, boils at 212°, and alcohol at 172°. But mixtures of water and alcohol boil at intermediate temperatures. Now, paraffine oil is a mixture of substances boiling between 300° and 500°. These substances have been examined, and several individuals have been isolated, which undoubtedly have the same composition as olefiant gas. But some have been found which contain a less quantity of carbon than olefiant gas; so it is impossible to say that the oils have the same composition as olefiant gas. An experiment of Sir B. Brodie will elucidate the question. He took a bent tube, introduced some paraffine, and then sealed the open end. He thus had a glass tube containing paraffine, closed at both ends. He then applied heat to the paraffine until it passed to the other end of the tube, and afterwards distilled it back again. After two distillations he found that the paraffine would no longer solidify, and after distilling it six or seven times the tube burst from the production of gas. The liquid portion no longer contained a trace of solid paraffine, but was found to consist of an oily substance boiling between 300° and 500°. So that to my mind Sir B. Brodie has succeeded in converting paraffine into paraffine oil, and at the same time into olefiant gas, which was obviously the cause of the explosion.

The other subjects upon which Dr. Hofmann was examined will be better understood from the evidence of subsequent witnesses. We have necessarily given Dr. Hofmann's evidence at some length. With the other witnesses for the plaintiff we shall only give such evidence as may be contradictory, or in which new matters are introduced.

The judgment in this important case is being delivered as we go to press, and we shall give it next week. On announcing his intention to deliver his judgment, the learned Vice-Chancellor remarked that the case had given him great labour out of Court, which he would not regret if it had advanced the administration of justice one whit. But the fact was, that nineteen-twentieths of the evidence was foreign to the case, and only increased the expense, and delay and loss of time to the public. After perusing much of the evidence, we quite agree with the Vice-Chancellor, that the greatest part was foreign to the case; but as some points of general interest to chemists and to manufacturers were introduced, we shall continue our abridgements.

(To be continued.)

The Medical Council and Pharmacy.—At the last meeting of the Council the following resolution was moved by Dr. Corrigan, seconded by Dr. Quain, and agreed to:—"That a communication be addressed to the Secretary of State for the Home Department, drawing his attention to the present defective state of the law regarding the practice of pharmacy, under which any person, however ignorant, may undertake it; and expressing the opinion of the General Medical Council that some legislative enactment is urgently called for to insure competency in persons keeping open shops for dispensing medicines and for the compounding of physicians' and surgeons' prescriptions."

ANSWERS TO CORRESPONDENTS.

Mr. Newland.—Received with thanks. The cause of the error will be inquired into.

Mr. W. Sydney Gibbons.—Received, with thanks.

A Manufacturer.—We have answered your question many times. The Commissioners will not sell the Chemical Report separate from the others.

G. W.—The estimation of small quantities of starch is a very difficult matter. The process you mention is, perhaps, the best for the purpose. It will be necessary to boil for some time; a very little acid will suffice.

Errata.—Page 240, column 1, *for* carbonic acid *read* carbonic oxide. We have also to correct a slight error in the percentage calculation of the water in thallium-iron alum, p. 205. In place of 33·147, it should be 32·029.

S. T. B. will see the correction above.

Book Received.—"Class Book of Rudimentary Chemistry." By the Rev. Geo. Pope, M.A.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

A New Method of Producing Aldehydes,
by M. Carstanjin.

The different processes for preparing aldehydes consist essentially in—

1st. The oxidation of alcohols.

2nd. The oxidation of nitrogenised matters, such as albumen, gelatine, &c.

3rd. The dry distillation of salts from fatty acids.

4th. The same distillation conducted with that of the formiates of lime and baryta.

5th. The distillation of albuminoid substances.

6th. The dehydration of glycols.

On the strength of several observations, the author thinks himself justified in laying it down as a general fact that an aldehyde is always to be obtained by submitting an ammoniacal base to a proper oxidation. Among them is the acetic aldehyde $C_4H_4O_2$ rapidly developed when ethylamine is poured on crystallised permanganate of potash. At first violet, the liquid turns green, developes heat on shaking, becomes brown with effervescence, and finally evolves the aldehyde, so perceptible by its odour. The gas of the reaction passed into an ammoniacal solution of silver, promptly reduces it, forming a metallic silver mirror.

With methylamine he has obtained a strongly reducing gaseous compound like the above, and, like it, capable of forming a crystalline compound with ammonia. He has not analysed it, but believes it to be the hitherto unfound aldehyde of methyle.

With trimethylamine a compound is produced which the author believes to be identical or isomeric with propylamine.—*Journal de Pharm. et de Chemie*, xlv., 100. 64.

A New Quadruple Salt, by M. Peltzer.

By treating sulphate or acetate of copper by hyposulphite of soda there results, as is well known, a double sulphite, which has been studied by M. Lenz and M. Rammelsberg. This hyposulphite is soluble in ammonia, to which it imparts a blue colour, and when left to itself the solution deposits a mass of blue crystals which constitute the new salt.

It may be obtained still more easily in the following manner:—Divide into two equal parts a mixture of sulphate of copper; supersaturate one with ammonia and the other with hyposulphite of soda, and mix the two solutions; by shaking the mixture, the new product is deposited in a crystalline mass of a beautiful violet colour.

The latter gives out a decided ammoniacal odour, especially if reduced to powder; it will bear a temperature of 100° C. Heated in a tube it loses no water, but forms a white sublimate which becomes orange by cooling. When boiled with water this sublimate emits ammonia, and on the addition of hydrochloric acid there follows a disengagement of sulphurous gas, which shows the sublimated product to contain M. H. Rose's sulphate—ammon.

Mixed with chlorate of potash, it detonates with some violence.

Water, especially when hot, decomposes but does not dissolve it; a green matter and white flakes of a salt of protoxide of copper are formed, and ammonia is disengaged; by prolonged boiling sulphide of copper is formed.

The new salt is soluble in ammonia, hyposulphite of soda, and acetic acid. Heated with potash it deposits at the boiling point a mixture formed of protoxide and deutoxide of copper.

The solar rays decompose the acetic solution, hypochlorite of soda also destroys it, forming a white precipitate containing protoxide of copper and tetrathionic acid.

Nitrate of silver produces a white precipitate; the precipitate, however, soon disappears to give place to a green deposit soluble in ammonia, but easily giving a deposit of sulphide of silver. The deposit contains copper, silver, and hyposulphurous acid. The author is of opinion that iron, zinc, and silver may be substituted for copper; besides, ferruginous sulphate of copper gives a quadruple salt containing iron.

The author has found for the percentage composition of this salt—

Cu_3O_2	27·76
NaO	15·52
NH_3	8·52
S_2O_2	48·19

thence he deduces the formula—

$$S_2O_2Cu_2O,S_2O_2CuO + 2(S_2O_2NaO) + 2AzH_3{}^*.$$

According to him ammonia here plays only a passive part, acting in the same way as water of crystallisation. —*Journal de Pharmacie et de Chemie*, xlv., 101. 64.

TECHNICAL CHEMISTRY.

The Formation of Aniline Yellow.—Researches on Aniline Colours, by M. Schiff.

Aniline Yellow.—This matter, which M. Schiff has often produced in the course of his researches on aniline colours, is, according to him, easily prepared by means of hydrated antimonic or stannic acid.

The alkaline antimoniate or stannate is pounded with half its weight of aniline, to the consistence of a clear *bouillie*, then hydrochloric acid is added till the acid reaction takes place. It is then shaken up, and the scarlet colour removed by etherised alcohol, the mass being, of course, previously dried. After proper purification it is allowed to evaporate spontaneously, and in this way are formed flakes of a hydrochlorate, having for base a red colouring matter, which must not be confounded with rosaniline.

When this hydrochlorate is decomposed by alkalies, deep yellow flakes are deposited, which again become red in presence of acids.

By impregnating silk or wool with this red colour, and then passing it into a hot solution of carbonate of soda, a beautiful yellow tint is developed, similar to the yellow of picric acid, and which the author believes to possess considerable stability.

Aniline yellow, then, may be developed on the stuff itself, by first producing the red above described, which, as has been shown, may easily be done by means of the stannate of soda so much used in dyeing.

The author has not yet decided on the composition of these colouring matters, but intends making them the subject of a future communication.—*Journ. de Pharm. et de Chem.*, xlv., 110, 1864.

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* This empirical formula may be decomposed into—

$$S_2O_2Cu_2O.S_2O_2NaO+S_2O_2CuO,S_2O_2NaO+2AzH_3.$$

which gives a quadruple salt differing from those already known only in containing three different bases and one acid.

PHYSICAL SCIENCE.

On the Electrical Relations of Metals, &c., in Fused Substances, by George Gore, *Esq.*

In the following experiments most of the substances to be fused were contained in small porcelain crucibles, and heated by means of the flame of a Bunsen's burner; the more infusible bodies were melted in clay crucibles in one of my small gas furnaces, particular care being taken to have neither an excess of gas nor of air in the furnace, by testing at the top of the chimney for carbonic oxide by means of a brightly red hot rod of iron, and diminishing the supply of gas until all traces of carbonic oxide precisely disappeared. The condition of the contents of the crucible could at all times be ascertained without admitting air into the furnace by placing upon the top of the furnace a vertical tube of fireclay about four inches high closed at its upper end by a thin disc of glass.

The materials of which the electrodes were composed included carbon, magnesium, aluminium, silicium, zinc, tin, lead, iron, nickel, copper, silver, gold, and platinum. The carbon consisted of bars of gas-graphite as used for electric lamps; the magnesium was a rod of Mr. Sonstadt's purest variety; the aluminium was obtained from Messrs. Bell, of Newcastle; the silicium was in the form of lumps obtained by fusing the finest crystals under a mixture of powdered Bohemian glass, silico-fluoride of potassium, and a little hydrate of potash; the zinc, tin, and lead were of the best commercial kinds; the iron was "pianoforte wire;" the rod of nickel was kindly given to me by Mr. H. Wiggin, of the firm of Evans and Askin, Birmingham; the copper was ordinary wire of commerce; the silver and gold were of "virgin" quality; and the platinum was obtained from Messrs. Johnson and Matthey, London.

The most superficial consideration of the conditions of these experiments will show that a number of interfering circumstances were more or less necessarily present, and that the results obtained are not in all cases simply and purely due to chemico-electric action; for instance— 1. thermo-electric action of the heated and immersed ends of the electrodes; 2. Ditto of the ends of the electrodes out of the fused substance, which in many cases could not be removed a sufficient distance to be out of the influence of the heat; 3. The chemical influence of infusible or insoluble films formed upon the immersed electrodes; 4. The accumulation of liquid of different composition around the electrodes; 5. Evolution of gases at the electrodes; 6. Alteration of structure of the electrodes by heat, their semifusion, etc.; 7. Currents occurring when by the relative coldness of the electrodes the fused salt around them solidified; and 8. In addition to all these, the interference of impurities in the fused substances and in the electrodes themselves.

It will at once be seen that some of these interferences could not be prevented or avoided; with regard to the others every reasonable precaution was taken, and the results in each uncertain case properly verified.

In the following lists the most positive substance is in each case named first, and substances united by the mark — were about equally positive:—

With fused boracic acid the following order of electrical relations was found: Iron, silicium—carbon, platinum, gold, copper, silver. The currents obtained were very feeble.

Glacial phosphoric acid: Zinc, iron, copper, silver, platinum. The copper, iron, and zinc dissolved quickly; some of the gas evolved by the zinc exploded.

Large crystals of iodine which had long been exposed in a bottle near lumps of fused chloride of calcium, gave, when fused, feeble currents with silver and platinum, the former being positive.

Fused selenium yielded no currents with platinum and copper or silver.

Sulphate of ammonia: Zinc, copper, silver, iron, platinum, carbon. Copper evolved much gas, and dissolved violently.

Nitrate of ammonia: Magnesium, zinc, lead, copper, silver, tin, aluminium, iron, silicium—carbon, platinum. Lead was very strongly positive to copper without manifesting strong chemical action. Zinc evolved gas violently.

Hydrate of potash: Silicium, aluminium, zinc, iron, lead (?), carbon, copper, platinum, silver. Silicium was strongly positive to aluminium, and strongly acted upon with evolution of gas. The results were variable with copper and platinum, and with platinum and silver.

Borate of potash: Iron, zinc, copper, silver, platinum.

Phosphate of potash: Zinc, iron, copper, silver, platinum.

Sulphide of potassium: Aluminium, zinc, copper, silver, platinum, carbon, iron. Copper and silver dissolved rapidly with violent action. Reversals of current occurred with platinum and aluminium, silver and aluminium, aluminium and zinc, iron and platinum, iron and carbon, silver and copper.

Iodide of potassium: Aluminium, zinc, iron, silver, copper, platinum. Reversals of current with copper and silver, copper and platinum, iron and zinc, probably from salt solidifying round the electrodes and subsequently fusing.

Bromide of potassium: Zinc, iron, copper, silver, platinum. Reversal of current with iron and zinc.

Chloride of potassium: Aluminium, zinc, iron, copper, silver, platinum. Reversals with silver and platinum, silver and copper, silver and iron, iron and copper, iron and zinc.

Chlorate of potash: Zinc, aluminium — iron, silver, copper, platinum. The currents were feeble; they were also indefinite until gas was evolved.

Nitrite of potash: Aluminium, zinc, copper, silver, iron, platinum.

Nitrate of potash: Tin, lead, aluminium, carbon, copper, iron, zinc, platinum, silver. Currents very feeble. Reversals with iron and platinum, iron and silver, carbon and copper. Carbon evolved much gas.

Hydrate of soda: Zinc, iron, carbon, copper, silver, platinum. Reversals with silver and platinum, copper and iron, carbon and iron. Moving either platinum or silver made each more positive.

Biborate of soda: Zinc, carbon, iron, copper, silver, platinum. Iron and zinc evolved gas.

Mono-pyrophosphate of soda: Iron, copper, silver, carbon, platinum. Reversal with silver and carbon.

Sulphide of sodium: Zinc, copper, silver, iron, platinum, carbon. Reversals with iron and carbon, iron and platinum, iron and silver. Iron much dissolved.

Hyposulphite of soda (aqueous fusion): Zinc, carbon, copper, silver, iron, platinum.

Bisulphate of soda (aqueous fusion): Iron, copper, silver, carbon, platinum. Reversal with iron and platinum. Gas evolved by iron.

Iodide of sodium: Iron, silver, copper, carbon, platinum. Reversals with platinum and silver, platinum and copper, platinum and carbon, carbon and copper, copper and silver, copper and iron, silver and iron.

Bromide of sodium: Zinc, iron, copper, silver, platinum. Reversals with platinum and silver, iron and zinc.

Chloride of sodium: Iron, copper, carbon, silver, gold, platinum. Reversals with carbon and copper, carbon and iron.

Nitrate of soda: Aluminium, zinc, carbon, copper, silver, iron, platinum. Reversals with silver and iron, carbon and copper, iron and copper. Carbon evolved much gas.

Microcosmic salt, aqueous fusion: Zinc, iron, silver, copper — platinum, carbon.

A mixture of carbonates of potash and soda: Silicium, iron, zinc, carbon, copper, silver, platinum. Reversals with platinum and silver, silver and copper, copper and carbon. Silicium was strongly positive to iron, and much action and gas at the surface of silicium.

A mixture of fluorides of potassium and sodium: Silicium, iron, carbon, copper, silver, platinum. Electric currents strong. Silicium rapidly acted upon and dissolved, and evolved much gas.

Carbonate of lithia: Iron, carbon, copper, silver, platinum. Reversals with platinum and silver, copper and carbon. Much effervescence.

Iodide of barium: Iron, carbon, silver — copper, platinum. Reversal with copper and silver; either was positive when moved. Silver freely dissolved.

Bromide of barium: Iron, carbon, copper, silver, platinum. Reversals with silver and copper, copper and iron, carbon and iron.

Nitrate of baryta: Zinc, carbon, copper, silver, iron, platinum. Reversal with copper and silver. Carbon evolved much gas, which appeared to make it negative to copper, and to silver especially. Iron evolved much gas.

A mixture of caustic baryta and the fluorides of potassium and sodium: Silicium, iron, carbon, copper, silver, platinum. Carbon evolved gas, iron much gas, and silicium very much gas.

Nitrate of strontia: Carbon, platinum, iron. Reversal with iron and platinum.

Iodide of calcium, aqueous fusion: Silver positive to platinum.

Bromide of calcium, aqueous fusion: Zinc, copper, iron, platinum.

Nitrate of lime: Silver, copper, platinum, iron, carbon.

Nitrate of magnesia, aqueous fusion: Zinc, silver, iron, silicium, carbon, platinum.

Silicate of potash (water glass): Copper, silver, platinum.

Bohemian glass: Carbon positive to iron. Current feeble.

A mixture of fine white sand and hydrate of potash: Nickel positive to carbon.

Silico-fluoride of potassium: Silicium, iron, carbon, copper, silver, platinum. Iron and silicium evolved gas.

A mixture of soda-lime, white sand, and hydrate of soda: Carbon strongly positive to nickel.

Tungstate of soda: Aluminium, iron, copper, silicium, carbon, silver, gold, platinum. Reversal with gold and carbon.

Molybdic acid: Copper, silver, platinum, carbon. Silver and copper acted upon.

Bichromate of potash: Silver, copper, silicium, carbon, iron, platinum, gold. Reversal with copper and silver.

Chromate of soda: Iron, copper, carbon, silver, platinum, gold. Currents strong.

Chloride of manganese: Copper, silver, iron, carbon, gold, platinum. Currents strong.

Bisulphide of arsenic: Silver, iron, carbon. Silver dissolved rapidly.

Tersulphide of arsenic: Copper, iron, platinum.

Teriodide of arsenic: Silver positive to platinum. Bad conductor.

Arsenite of soda: Iron, silicium, carbon, silver, copper, platinum. Reversals with silver and carbon. Iron, silicium, and carbon evolved much gas. Platinum, copper, and silver rapidly melted in it.

Teroxide of antimony: Silicium, iron, carbon, copper —silver, platinum. Reversal with silver and copper.

Tersulphide of antimony: Silver, copper, zinc, iron, silicium, platinum, carbon. Reversals with platinum and iron, copper and silver. Copper and silver dissolved quickly.

Teriodide of antimony: Silver, zinc, copper, iron, carbon, platinum. Currents feeble.

Terbromide of antimony: Copper, silver, zinc, iron, platinum, carbon. Reversal with zinc and iron. Currents very feeble.

Oxybromide of antimony: Silicium, iron, copper, silver, carbon, platinum, gold. Silver and copper dissolved quickly.

Fluoride of antimony: Zinc, iron, copper, silver, carbon, platinum. Iron coated itself black.

Bromide of zinc: Copper, iron, silver, platinum.

Chloride of cadmium: Aluminium, zinc, iron, copper, silver, platinum. Reversal with silver and copper. Zinc melted quickly; aluminium similar, with violent action.

Mineral phosphate of lead: Iron positive to carbon. Strong action upon iron, and iron dissolved; gas also evolved from carbon. Much lead reduced to a metallic button.

Iodide of lead: Zinc, silver, copper, iron, platinum. Reversals with platinum and iron, silver and zinc. Copper and silver dissolved rapidly.

Chloride of lead: Zinc, lead, copper, iron, silver, platinum. Reversals with copper and silver, copper and iron.

Chromate of lead: Carbon positive to iron. Strong action and intense heat at surface of iron. Iron much dissolved; carbon also corroded.

Black scale oxide of iron mixed with silica: Iron, carbon, platinum. Reversal with iron and carbon. Current strong with iron and platinum. Iron dissolved.

Black oxide of copper: Platinum positive to iron as long as the iron was enveloped by an unfused coating of oxide of copper, then violent action upon the iron, attended by evolution of intense heat and very rapid solution of the iron, the iron becoming, at the same time, strongly positive to platinum. A large button of reduced copper was formed. Protoxide of copper appears to evolve oxygen gas when fused.

The following inferences may be deduced from these experiments:—

The most negative substances in fused salts are generally platinum, gold, carbon, and silver; the most positive substances are generally magnesium, aluminium, and zinc. Silicium is generally electro-positive to carbon, and is strongly positive and quickly corroded in fused alkalies, alkaline carbonates, or fluorides. Carbon is not generally very positive to iron.

The following facts may also be noticed:—

Copper and silver dissolve rapidly in fused sulphide of potassium, tersulphide of antimony, or iodide of lead; silver also dissolves freely in iodide of barium and bisulphide of arsenic. Platinum, copper, and silver rapidly melt in fused arsenite of soda. Electric currents were repeatedly observed whilst one (or both) of the electrodes was coated with unfused salt, and on the fusion of the saline coating strong currents in an opposite direction generally occurred.

The investigation was very suggestive of new experiments; it suggested the examination of the various phenomena which acted as sources of interference, which I have already enumerated; it also threw light upon the desirable object of obtaining a cheap source of electricity by the combustion of coke or gas carbon. The discovery of some suitable fused salt or mixture in which carbon is highly electro-positive at a high temperature to iron, nickel, or other infusible and suitable conductor would probably prove a cheap and powerful source of electricity; cheap because of the low equivalent number of carbon and the low price of coke and gas carbon, and powerful because of the intense affinity of carbon for oxygen at high temperatures—sufficient, indeed, to set the alkali metals free from their oxides. The nearest approach in these experiments to this object was with carbon and nickel in a fused mixture of soda, lime, and silica.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 15, 1864.

"*On the Chemical History and Application of Gun-cotton,*" *by Professor* Abel, *F.R.S., Chemist to the War Department.*

(*Continued from page 257.*)

Many attempts have been made from time to time to diminish the rapidity of explosion of gun-cotton, but the only one which has been attended by any success is that which, in General von Lenk's hands, has led to the development of a system of mechanical arrangement of gun-cotton as ingenious and simple as it is effective. By manufacturing the cotton into yarn of different thickness and degrees of compactness or firmness of twist, *before* its conversion into gun-cotton, this material is at once obtained in forms which not only burn with great regularity and much less rapidity, when used in the original condition, than the loose gun-cotton wool, but which also, when employed in the form of reels, wound more or less compactly, or, by being converted into plaits or hollow ropes, may be made to burn gradually in a manner similar to gunpowder, or to flash into flame instantaneously, exerting an explosive action which very far exceeds that of the latter. The modifications in the nature and degree of explosive force exerted by gun-cotton which are essential for its application to military and industrial purposes as a substitute for powder are, therefore, arrived at by means of very simple variations in the mechanical condition of the material. Thus, to obtain the gradual action essential for the employment of gun-cotton in cannon, cartridges are made up of coarse yarn, which is wound firmly round a hollow cylinder of wood, the dimensions of which are regulated by the size of the gun-chamber and the weight of the charge used; the best result is obtained by so arranging the latter that the cartridge entirely fills the space allotted to the charge in the gun. Similarly, small-arm cartridges are made of cylindrical plaits of fine yarn or thread, which are fitted compactly in layers, one over the other, upon a small cylinder or spindle of wood. In both of these arrangements the combustion of the charge can proceed only from the exterior surfaces towards the interior of the cartridge. On the other hand, the charges for shells, in which the most rapid explosion is most effective, and the priming for quick-matches which are intended for firing several charges simultaneously and almost immediately upon the application of flame, consist of cylindrical, hollow, and moderately compact plaits (similar to lamp-wicks), made of gun-cotton thread or very fine yarn. These plaits are produced in pieces of any length, and, when employed as quick-match, are compactly enclosed in cases of waterproof canvas or other similar materials. The charges to be used in mines, in which the most destructive effects are aimed at, consist of pieces of very firmly twisted rope, with a hollow case along the centre, the number of strands of which it is composed varying with the size of the charge to be used. For quarrying and blasting purposes suitable lengths of the rope are employed singly; for military operations (demolition of works, &c.), it is packed into moderately stout cases of sheet metal. In these hollow ropes and plaits of gun-cotton, the flame produced by the burning of that portion to which heat is applied, penetrates at once to the interior and into the interstices of the charge; and hence the entire mass of gun-cotton is converted into gas and vapour with almost instantaneous rapidity. A striking illustration of the very opposite effects which can be produced by very simple modifications in the mechanical arrangement of the gun-cotton is afforded by the following experiment :—If two or three strands of gun-cotton yarn be very loosely twisted together and inserted into a tube of glass or other material, in which they fit so loosely as to be readily drawn backwards and forwards, upon applying heat to a projecting portion at one end of the tube, the gun-cotton thus arranged will explode with great violence, completely pulverising the tube, if it be of glass, and the combustion will take place with such almost instantaneous rapidity that small portions of unburnt gun-cotton will actually be scattered by the explosion. But, when two or more strands of the same gun-cotton yarn be tightly twisted, singly in the first instance, then made up into a firm cord solid throughout, and enclosed in a glass tube, or some other description of case, into which the cord fits very tightly, if a protruding end of the gun-cotton be inflamed, the cord will burn with moderate rapidity until the fire reaches the opening of the case, and then the combustion will pass over from the ordinary kind to a form which can only be described as a smouldering : the lighted extremity of the gun-cotton simply glows within the case, while a steady jet of flame (furnished by the combustible gases evolved from the gun-cotton) continues to burn at the open extremity of the case until the contents of the latter are consumed. The gun-cotton not only burns extremely slowly under these conditions, but also with the greatest regularity; so that the rate of combustion of a given length of the enclosed cord may be accurately timed. The rapidity of combustion of gun-cotton arranged in this form may be regulated by the number of strands in a cord and the degree of their compactness; and it is by this new modification of General von Lenk's system of arranging gun-cotton that the lecturer has succeeded in applying this material to the production of slow-matches and time-fuses—uses for which it had not previously been found suitable.

Reference has just been made to inflammable gases evolved by gun-cotton while it undergoes a very slow combustion. The composition of gun-cotton renders it self-evident that under any circumstances the explosion of this substance must be accompanied by the production of a very considerable proportion of carbonic oxide. The large body of flame always observed when gun-cotton is ignited under ordinary circumstances, is principally due to the combustion of carbonic oxide, and probably also of small quantities of carbo-hydrogen compounds, which, together with minute suspended particles of the mineral matter contained in the gun-cotton, give to the flame its brightness. If a tuft of gun-cotton be ignited in a capacious and somewhat deep vessel, the flame actually resulting from the burning of the tuft may be distinctly seen surrounded by a large body of flame, produced by the burning gases, which continues apparent for a very appreciable time after the disappearance of the flash of flame furnished by the explosion of the gun-cotton. If similar tufts be ignited in atmospheres of hydrogen, nitrogen, carbonic acid, coal-gas, &c., the combustion of the gun-cotton is only accompanied by a very small and pale flame, of instantaneous duration. Similarly, if gun-cotton be ignited in a vessel which has been previously exhausted to any rate one half the ordinary atmospheric pressure, the proportion of air, and therefore of oxygen, present when the gun-cotton is ignited, does not suffice to effect the combustion of any large proportion of the inflammable gases generated, and hence the explosion of the gun-cotton is attended only by a small pale flame. If, however, the vessel be filled with oxygen, and then exhausted to an equal or even a lower degree, it is filled with flame of dazzling brightness directly the ignition of the gun-cotton is effected.

The one modification, just referred to, of the phenomena which attend the ignition of gun-cotton in a rarefied atmosphere is not the only result observed in experiments of this kind. Various curious effects may be obtained, their nature being determined by the degree of rarefaction of the atmosphere; the mechanical condition of the gun-cotton; its position with reference to the source of heat employed; and other variable elements in the experiments. A brief account of some of the principal of these phenomena may not be without interest.

In the experiment with a tuft of gun-cotton in rarefied air, spoken of just now, a perceptible interval is observed between the first application of heat (by passage of a voltaic current through a platinum wire enclosed in the tuft) and the first appearance of ignition of the gun-cotton; moreover, the pale flame, observed when the latter does burn, is of very perceptibly longer duration than that of the bright flash which attends the explosion of gun-cotton in air under ordinary conditions. If, instead of using the gun-cotton in the form of a tuft, a short piece of the gun-cotton-yarn be employed in the experiment, and laid on a support so that it rests upon the wire by which it is to be ignited, the pale flame of the burning gun-cotton will travel along towards the two extremities of the piece of yarn with a degree of slowness corresponding to the extent of rarefaction of the atmosphere. These results are in perfect accordance with the observation first made by Quartermaster Mitchell, afterwards fully examined into by Frankland, and recently amplified by Dufour, that the rate of burning of time-fuses is influenced by the altitude at which they are burned, or, in other words, by the degree of pressure of the atmosphere, the combustion being proportionately slow with every decrement of pressure of the air. When the platinum-wire is first raised to a red heat in the centre of the tuft of gun-cotton, enclosed in a highly-rarefied atmosphere, the products resulting from the decomposition of that portion of the material which is in close contact with the wire, immediately distribute themselves through the rarefied space, conveying away and rendering latent by their great expansion the heat furnished by the platinum-wire and that which results from the chemical change. The increase of pressure within the confined space, by the generation of the gases and vapours, on the one hand, and, on the other hand, the effect of the heated gases, which escape, upon the particle of gun-cotton through which they permeate, result, in the course of time, in the ignition of the mass; but, even then, the gun-cotton burns only slowly, because, in consequence of the rapidity with which the resulting gases and vapours escape and expand, much of the heat essential for the maintenance of the combustion is at once conveyed away. The latter result is strikingly exemplified by the experiment in which gun-cotton-yarn is substituted for the tuft of carded gun-cotton; indeed, if the atmosphere be very highly rarefied (to 0·6 in inches of mercury), and a sufficient length of the gun-cotton-yarn (4 or 5 inches) be employed in the experiment, the burning of the material induced by the heated wire will proceed so slowly that the heat resulting from the chemical change will be conveyed away from the burning surface, by the gases generated, much more rapidly than it is developed; so that the gun-cotton will actually become extinguished when only a small portion of it has been burned.

A very similar result is obtained if gunpowder, either in the form of grains or of one large mass, is exposed to the action of an incandescent platinum wire imbedded in it, the pressure of the atmosphere in the apparatus in which the experiment is made being reduced to between 0·6 and 2 in inches of mercury. The portion of gunpowder contiguous to the heated wire will fuse, vapours of sulphur will be evolved in the first instance, and subsequently the charcoal will be oxidised by the nitre, bubbles of gas escaping from the fused mass. The vapours and gases thus generated convey away rapidly the heat provided by the wire and developed by the chemical action; and, at the same time, the change which the gunpowder undergoes diminishes its explosive character, so that its partial ignition or explosion will only be effected after the lapse of several minutes, and, if it be in the form of grains, the explosion of the particles contiguous to the wire will have the effect of scattering the remainder without igniting it.

The great reduction in the rapidity of combustion of gun-cotton is not the only result observed when small quantities of that substance are exposed to heat under diminished atmospheric pressure. In the most highly rarefied atmospheres (from 0·5 to 1 inch) the only indication afforded of the burning of the gun-cotton is the appearance of a beautiful green glow, like a phosphorescence, immediately surrounding that part which is undergoing decomposition. When the pressure of the atmosphere is slightly increased, a faint yellow lambent flame appears beyond the green glow, at a short distance from the point of decomposition; and, in proportion as the atmosphere is less rarefied, this pale yellow flame increases in volume, while the green phosphorescence becomes less and less apparent until it seems to be completely obliterated. Lastly, when the pressure of the atmosphere is comparatively great (=25 or 26 in inches of mercury) the gun-cotton burns with the ordinary bright flame, though less rapidly, of course, than it does under normal conditions of atmospheric pressure. There is no doubt that this bright flame is due to an almost instantaneous secondary combustion (in the oxygen supplied by the air in the apparatus) of the inflammable gases evolved by the decomposition. On the other hand, the production of the small pale flame observed when gun-cotton is burned in more highly rarefied air, or in atmospheres of gases which cannot supply oxygen for combustion, is most probably due to the generation of a mixture of gases (by the change which gun-cotton undergoes under these conditions), which contains not only combustible bodies, such as carbonic oxide, but also a proportion of oxidising gases (protoxide of nitrogen, or even oxygen); such a mixture, having self-combustible properties, will receive sufficient heat from the burning gun-cotton to become ignited, except when the atmosphere in which the change takes place is so highly rarefied that the heat is immediately dissipated, and the gases evolved become highly attenuated, as already described.

It will be readily conceived that the mechanical state of the gun-cotton (*i.e.*, the particular form in which it is employed), like other variable conditions which have been alluded to, will greatly influence the nature of phenomena observed when this substance is ignited in air, or in various gases, either at ordinary or diminished pressures. This may be exemplified by the following experimental illustrations. It has been stated that, when a tuft of carded gun-cotton is ignited in carbonic acid, carbonic oxide, nitrogen, coal gas, hydrogen, and other gases, it burns only with a pale yellow flame; this flame, when furnished by equal quantities of gun-cotton, is much smaller in an atmosphere of hydrogen than it is, for example, in carbonic acid; a fact which must be ascribed to the comparatively very rapid diffusion of the generated gases when hydrogen is used. In operating with pieces of gun-cotton yarn, instead of employing loose tufts, the material, when ignited by a red-hot wire in atmospheres of carbonic acid, nitrogen in carbonic oxide, burns much more slowly than it does in air under the same conditions; and its combustion is accompanied only by a very small jet or pointed tongue of pale flame, which is thrown out in a line with the burning extremities of the piece of yarn. In the same way, if the yarn is enclosed in a tube or other vessel through which those gases are circulating, and from which one extremity of the gun-cotton protrudes, when the latter is lighted it will burn in the ordinary manner only until it reaches the opening of the tube, when the form of combustion will at once be changed to that just described. If, however, corresponding experiments are made in atmospheres of hydrogen or coal gas, the gun-cotton yarn will burn in the slow manner described, but only for a very brief period—indeed, it ceases to burn at all almost instantaneously, just as it does when ignited in a very highly rarefied atmosphere. This result is not due to the high diffusive powers of the gas in which the gun-cotton is burned, as it may be obtained equally in open and in perfectly closed vessels; it can, therefore, only be ascribed to the high cooling powers, by convection, of the gases employed. Pure nitrogen, as stated just now, allows the gun-cotton yarn to burn in the slow manner, but if mixed with one-fourth its volume of hydrogen it arrests the combustion of the material, just like coal gas or pure hydrogen.

(To be continued.)

ROYAL SOCIETY.

Thursday, May 26, 1864.

Professor W. A. Miller, *V.P., in the Chair.*

The following paper was read:—"*Note on the Variations of Density produced by Heat in Mineral Substances,*" by Dr. T. L. Phipson, F.C.S.:—That any mineral substance, whether crystallised or not, should diminish in density by the action of heat might be looked upon as a natural consequence of dilation being produced in every case and becoming permanent. Such diminution of density occurs with idocrase, Labradorite, feldspar, quartz, amphibole, pyroxene, peridote, Samarskite, porcelain, and glass. But Gadolinite, zircons, and yellow obsidians augment in density from the same cause. This again may be explained by assuming that, under the influence of a powerful heat, these substances undergo some permanent molecular change. But in this note I have to show that this molecular change is not permanent, but intermittent, at least as regards the species I have examined, and probably with all the others. Such researches, while tending to elucidate certain points of chemical geology, may likewise add something to our present knowledge of the modes of action of heat. My experiments were undertaken to prove an interesting fact announced formerly by Magnus—namely, that specimens of idocrase after fusion had diminished considerably in density without undergoing any change of composition: before fusion their specific gravity ranged from 3·349 to 3·45, and after fusion only 2·93 to 2·945. Having lately received specimens of this and other minerals brought from Vesuvius in January last by my friend Henry Rutter, Esq., I determined upon repeating this experiment of Magnus. I found, first, that what he stated for idocrase and for a specimen of reddish-brown garnet was also the case with the whole family of garnets as well as for the minerals of the idocrase group; secondly, that it is not necessary to melt the minerals: it is sufficient that they should be heated to redness without fusion, in order to occasion this change of density; thirdly, that the diminished density thus produced by the action of a red heat is not a permanent state, but that the specimens, in the course of a month or less, resume their original specific gravities. These curious results were first obtained by me with a species of lime garnet in small yellowish crystals, exceedingly brilliant and resinous, almost granular, fusing with difficulty to a black enamel, accompanied with very little leucite and traces of grossular, and crystallised in the second system. Specimens weighing some grammes had their specific gravity taken with great care, and by the method described by me in the Chemical News for 1862. They were then perfectly dried and exposed for about a quarter of an hour to a bright red heat. When the whole substance of the specimen was observed to have attained this temperature, without a trace of fusion, it was allowed to cool, and when it had arrived at the temperature of the atmosphere, its specific gravity was again taken by the same method as before. The diminution of density being noted, the specimens were carefully dried, enveloped in several folds of filtering paper, and put aside in a box along with other minerals. In the course of a month it occurred to me that it would be interesting to take the specific gravity again, in order to ascertain whether it had not returned to its original figure, when, to my surprise, I found that each specimen had effectively increased in density and had attained its former specific gravity. Thus:—

Lime garnet mellitite (from Vesuvius).

	Original density.	Density after being heated red-hot for a quarter of an hour and allowed to cool.	Density determined in a month after the experiments.
I.	3·345	2·978	3·344
II.	3·350	2·980	3.350
III.	3·349	2·977	3·345

The same experiments were made with several other minerals belonging to the idocrase and garnet family, and always with similar results. Now I ask, what becomes of the heat that seems to be thus shut up in a mineral substance for the space of a month? The substance of the mineral is dilated, the distance between its molecules is enlarged, but these molecules slowly approach each other again, and in the course of some weeks resume their original positions. What induces the change, or how does it happen that the original specific gravity is not acquired immediately the substance has cooled?* Will the same phenomenon show itself with other families of minerals or with the metallic elements? Such are the points which I propose to examine in the next place; in the mean time the observations I have just alluded to are proof that bodies can absorb a certain amount of heat not indicated by the thermometer (which becomes latent), and that this is effected without the body undergoing a change of state; secondly, that they slowly part with this heat again until they have acquired their original densities; thirdly, so many different substances being affected by a change of density when melted or simply heated to redness and allowed to cool, it is probable this property will be found to belong, more or less, to all substances without exception.

(To be continued.)

Royal Institution.—Monday, June 6, at two o'clock, General Monthly Meeting. Tuesday, June 7, at three o'clock, Professor Marshall, "On Animal Life." Thursday, June 9, at three o'clock, J. Hullah, Esq., "On Music (1600—1750)." Friday, June 10, at eight o'clock, Professor Tyndall, "A Magnetical Experiment." Saturday, June 11, at three o'clock, Alexander Herschel, Esq., "On Falling Stars and Meteorites."

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* Some minerals, like euclase, that become electric by heat, retain that state for a considerable time. The increase of density of Gadolinite and the decrease of density of Samarskite by action of heat, are accompanied by a vivid emission of light, as mentioned in my work on "Phosphoroscence," &c., pp. 31 and 32, where H. Rose's ingenious experiment is described.

ACADEMY OF SCIENCES.

May 23.

The great length to which our English reports extend this week obliges us to curtail our notice of the proceedings of the French Academy. This is of the less consequence, inasmuch as the memoirs and notes contributed at the last meeting are either of small interest or defy abridgment. The most important were contributions of physics by MM. Fizeau and Matteucci. The former was "*On the Dilatation and Double Refraction of Heated Rock Crystal*," and the latter "*On Electrical Earth Currents*." M. Boussingault gave another instalment of his memoir "*On Vegetation in Darkness*," to which we shall allude when the paper is concluded. The purely chemical papers included one by M. Wurtz "*On the Oxidation of the Hydrate of Amylene, and Isomerism in Alcohols*;" one by M. Reboul "*On the Bromides and Hydrobromates of Valerylene*;" and by Berthelot "*On the Action of Iodine and Hydriodic Acid on Acetylene*." These papers will shortly receive more extended notice. One other deserves attention—viz., that by M. Marigny, "*On the Artificial Formation of Galena and Copper Pyrites*," to which the author added some speculations "*On the Formation of Metalliferous Veins*."

NOTICES OF BOOKS.

Chemistry for Photographers: Le Preparateur-Photographe on Traité de Chemie a l'Usage des Photographes, &c., &c. Par le Dr. T. L. Phipson, &c., &c. Paris: Leiber. 1864.

An Englishman who produces a scientific work in a foreign language challenges a double criticism from the nation whose language he writes. Both his linguistic and scientific pretensions will be severely examined, and woe betide the adventurous author who fails to establish his reputation in either.

What a Frenchman will say to Dr. Phipson's French it would be hard for us to say. All we know is, that it is French which an Englishman can easily read, and that is no small merit in our estimation. Some one has said the same thing of the French of Pascal and Bossuet, which the author of this book may lay to heart if a modern writer should quarrel with his diction.

What the Frenchmen may say to the matter of the work it is not so difficult to tell. At the beginning, in a table of the simple bodies, the author gives symbols, some of which have long been discontinued, and others which we do not think were ever in use among French chemists. For example, the symbol of arsenic he writes Ar.; that of cœsium, Cœ.; chromium, Ch.; iodine, Io.; thallium, Th.; thorium, To. In the same table, too, there are obvious blunders in the names of the elements, but these we may suppose to be vagaries of the printer.

The first part of Dr. Phipson's book consists of a succinct statement of the general principles of chemistry. The Section concludes with a chapter on "the way to study chemistry," the first sentence of which we may seriously recommend to the attention of every student who wishes to advance the science. "Comme pour tout science, il faut, pour etudier convenablement la chemie, procéder le plus possible du connu a l'inconnu."

The author next proceeds with an account of the metalloids; and in the account of oxygen we note an omission, and meet with a passage which will perhaps bring the French critics down upon him. He tells his readers that the best way to obtain oxygen in the laboratory is to heat chlorate of potash over a spirit-lamp. Now, most people know that oxygen is to be procured much more easily from a mixture of chlorate of potash and binoxide of manganese. It is, in fact, so stated in all the French elementary works on chemistry we have met with. But, desirous of making a little capital for an Englishman, the author, after a reference to Deville's method of getting oxygen from sulphuric acid (in which, by the way, is a gross misprint), writes as follows:—

"More recently Mr. Matthey, of London, has decomposed in one operation twenty-two kilogrammes of chlorate of potash, mixed with an equal weight of peroxide of manganese. This mixture decomposes much more easily than the chlorate by itself."

There is much more, we fear, in the book with which Frenchmen may quarrel, and we must leave Dr. Phipson to the national criticism he challenges. Our duty is done when we have announced the publication of the work.

The Condensed Argument for the Legislative Prohibition of the Liquor Traffic. By Dr. F. R. Lees. London: Caudwell, Strand. 1864.

This work appears to have been sent to us not for review, but to obtain an opinion in favour of what is called the "Permissive Bill" of the United Kingdom Temperance Alliance. We can have no hesitation in expressing such an opinion, and should be very glad to see the bill pass, although we have many doubts whether it would not rather increase than diminish drunkenness. Into the argument we cannot enter, but of the book it is impossible to speak too highly.

NOTICES OF PATENTS.

Relating to the Production of Coal-tar Colours.

92. *Manufacturing Magenta Colour or Dye.* D. Dawson, Huddersfield. Dated January 12, 1863.

The patentee first produces the neutral arseniate of aniline by mixing together, in equivalent proportions, aniline and an aqueous solution of arsenic acid. This latter ingredient should contain from 23 to 30 per cent. of water, including the water of hydration. Such a solution is liable to deposit a certain quantity of the arsenic acid in the form of crystals, but these need not be separated, inasmuch as they will become dissolved and enter into combination with the aniline so soon as the mixture is heated. The arseniate of aniline is described as a solid substance, usually white, and having a somewhat crystalline aspect. At this stage the saline substance retains all the water originally present in the arsenical solution, and probably in the condition of water of crystallisation. The patentee next submits this product, in a strong iron cylinder or other appropriate apparatus, to a temperature varying between 345 and 360 degrees Fahrenheit, and under a pressure of 70 to 100 lbs. on the square inch. The heat is usually required to be maintained for a period of about twelve hours, but the interval of time must be regulated by the weight of material used in the operation and by the size of the apparatus. The result of this treatment is a red compound, which, after purification by well-known methods and subsequent solution, furnishes the magenta dye.

Pending the judicial settlement of the question at issue, it is only necessary to mention the circumstance that the main point of difference between this and Dr. Medlock's earlier claim is based upon the proportion of water contained in the materials used in the manufacture of this colouring matter.

117. *Manufacturing Colours for Dyeing and Printing.* J. A. Schlumerger, Basle, Switzerland. A communication. Dated January 14, 1863.

For the purpose of obtaining a pure blue colouring matter, which is particularly applicable to the dyeing of silk and woollen fabrics to be worn by night, the inventor transforms the ordinary red magenta salt into a compound which may be used as a blue dye when dissolved in alcohol or methylated spirit. The mode of proceeding is to mix with the hydrochlorate or other salt of rosaniline a suitable proportion (generally three parts) of the acetate of aniline, toluidine, or other homologous base, then to add an amount of carbonate of soda, or any alkali, for the purpose of liberating the organic bases. The mixture so obtained is then heated to a temperature which may vary between the limits of 180 and 210 degrees Centigrade, until on testing a portion the desired tint has been attained. The product is next boiled with hydrochloric acid and with water, in order to remove from it traces of purple or red compounds which are apt to survive the operation of conversion.

The details of this process, both as regards the system of production and the method of purification, are very similar to those described by Girard for effecting the same purpose.

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138. *The Manufacture of Colouring Matters.* C. H. Greville Williams. Dated January 15, 1863. (Not proceeded with.)

271. *Red Colouring Matter.* C. H. Greville Williams. Dated January 29, 1863.

These specifications refer to the employment of the acetate or phosphate of mercury for the purpose of forming red colouring matters with aniline or one of its homologues, or any salt of these bases, particularly the acetate, sulphate, nitrate, or hydrochlorate of aniline. The patentee prefers to use the materials in the proportion of two equivalents of aniline to one equivalent of the mercury salt. A mixture of the salts of aniline and toluidine may be employed, and, in addition, a certain quantity of uncombined aniline; these ingredients are heated together with the mercury salt until the desired colour is produced, and the product is dissolved in the usual manner for the purposes of the dyer.

The employment of a mercury salt in the preparation of magenta dye has hitherto introduced a difficulty in the purification of the product. There is no doubt that a considerable variation in the tint of the resulting colour is under the inventor's control.

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151. *Printing and Dyeing Textile Fabrics and Yarns.* J. Lightfoot. Dated January 17, 1893.

The inventor describes the use of several metallic oxides and salts which may be associated as mordants with certain compounds of aniline or homologous bases for the purpose of producing a black dye on yarns or textile fabrics.

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192. *Obtaining Colouring Matters.* H. Caro and J. Dale, Manchester. Dated January 21, 1863.

The patentees treat the red and purple coal-tar colours with acroleine, when, under the influence of heat, they become modified in tint. Likewise, they obtain a blue colouring matter by the action of aniline and benzoic acid upon mauve and purple dyes.

The result of the second process does not appear to be sensibly different from that produced by the action of aniline alone, which is well known to have the power, when assisted by heat, of modifying the colour of the red and purple dyes to the extent of changing them to blue.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1191. Thomas Walker, Birmingham, Warwick, "Improvements in means or apparatus for the utilisation of sewage matters, part of which improvements is applicable to raising and forcing other fluids. Petition recorded May 11, 1864.

1092. Frederick Leisz, New Coventry Street, Leicester Square, "Improvements in the manufacture of syrups."—A communication from Jean Jaques Grosheinz and Auguste Sheurer, Logelbach, near Colmar, Haut Rhin.—Petition recorded April 30, 1864.

1113. Peter Ward, Cloud's Hill Villas, St. George's, Bristol, "Improvements in lubricating compounds."—Petition recorded May 3, 1864.

1124. John Potter, Manchester, "A new compound or composition for artificial stone, and for certain machinery or apparatus to be used in mixing and applying the said composition."—Petition recorded May 4, 1864.

1136. Edward Beanes, Argyll Street, Middlesex, and Conrad William Finzel, Bristol, "Improvements in sugar boiling."

1138. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improvements in the means of, and apparatus for, generating heat."—A communication from Albert Borsig, Edward Freudenthal, and Alexander Daelen, Berlin, Prussia.—Petitions recorded May 5, 1864.

1156. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in apparatus for economising the consumption of gas."—A communication from Ernest Jourdan, Paris, France.

1166. Henry Woodward, Euston Road, Middlesex, "Improvements in apparatus for carburetting gas."—Petitions recorded May 7, 1864.

1172. Henry Aitken, Falkirk, N.B., "Improvements in the system or mode of calcining and extracting the oils and gases from ironstone and other materials, and in the apparatus or means employed therefor."

1174. Don Francisco Marques Millau del Real, Rue Mantrec, Bordeaux, France, "Improvements in extracting silver from lead."

1178. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improved apparatus applicable to the heating and evaporating of fluids."—A communication from Leopold Wiart, Cambrai, France.—Petitions recorded May 9, 1864.

1181. James Alfred Wanklyn, Finsbury Circus, "The manufacture of purple dye stuffs from manna sugar."

1188. David Jones and Bryan I'Anson, Birmingham, Warwick, "Improvements in casks or other vessels for the storing and preservation of wines, spirits, and other liquors or fluids, and for facilitating the drawing off of the same." Petitions recorded May 10, 1864.

1192. James Brown, Aldgate, London, and Astley Paston Price, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of blotting paper."

1196. Thomas Matthew Gisborne, Lymington, Southampton, "Improvements in kilns for burning bricks, tiles, and other earthenware or ceramic articles, limestone, and ores."—Petitions recorded May 11, 1864.

1203. William Horne, West Ham, Essex, "Improved methods of treating canvas, tarpaulings, or other painted canvas, to render them suitable for household and other useful purposes."—Petition recorded May 12, 1864.

1211. Edward Myers, Millbank Row, Westminster, and Thomas Guy Progers, Cambridge Street, Pimlico, "Improvements in wet gas meters."—Petition recorded May 13, 1864.

1243. Richard Archibald Brooman, Fleet Street, London, "Improvements in dyeing wool and other filamentous and textile materials, and in machinery employed therein."—A communication from Jean Henri Claudet, Rouen, France.—Petition recorded May 17, 1864.

Notices to Proceed.

112. Alfred Field Henery, Dorset Street, Manchester Square, Middlesex, "An improved galvanic belt."—Petition recorded January 15, 1864.

131. Carl Vogt, Cassel, Electorate of Hesse, "Improvements in the manufacture of pigments."—A communication from Ludwig Schad, Cassel, aforesaid.—Petition recorded January 18, 1864.

152. Thomas Lightfoot, Accrington, Lancashire, George

Powell Barnes, Manchester, Lancashire, and John Lightfoot, of Accrington, "Improvements in fixing colours on woven fabrics or fibrous materials."—Petition recorded January 20, 1864.

163. Edgar Townend Jarrold, Norwich, Norfolk, and George John Yates, Penketh, near Warrington, Lancashire, "Improvements in deodorising paraffine, petroleum, rock shale, and other hydrocarbon oils."—Petition recorded January 21, 1864.

390. Henry Walker Wood, Blackweir, Glamorgan, "Improvements in cylinders exposed to the direct action of fire, and employed in the manufacture of artificial fuel, and in heating and drying other substances."—Petition recorded February 15, 1864.

627. Robert Hanham Collyer, Alpha Road, St. John's Wood, Middlesex, "An improved apparatus and process for the conversion of substances into material for the manufacture of paper and textile purposes."—Petition recorded March 12, 1864.

990. Alexander Colvin Fraser, Loughborough, Leicestershire, "Improvements in apparatus used in the manufacture of gas."—Petition recorded March 20, 1864.

1081. Richard Archibald Brooman, Fleet Street, London, "A new method of treating wood and other ligneous substances in order to produce alcohol and to obtain the cellular tissue or fibre from such substances, applicable to the manufacture of paper and other uses."—A communication from François Marie Bachet and Etienne Machard, Annecy, France.

1087. Frank Clarke Hills, Deptford, Kent, "Improvements in, and applicable to, furnaces to be used in the manufacture of gas."

1088. Frank Clarke Hills, Deptford, Kent, "Improvements in the purification of gas, and in obtaining a valuable product in the process, and for the preparation of some of the materials to be used in the said purification."—Petitions recorded April 29, 1864.

MISCELLANEOUS.

YOUNG *v.* FERNIE.

(*Continued from page* 264.)

Dr. Lyon Playfair, examined by Mr. Grove. In the first part of his evidence, Dr. Playfair was taken over the same ground as Dr. Hofmann in his re-examination by Mr. Bovill, and gave substantially the same replies. On coming to De Hompesch's patent, the witness said he had made experiments on two kinds of coal, boghead and leeswood, both cannel coals. The first experiment was to ascertain the effect of a heat of 600°; for that purpose, he said, I took lead at its point of fusion. I placed boghead coal under melted lead for several hours, and when I took it out the coal was unchanged, a little water only had left it. There was a faint empyreumatic smell. I placed leeswood coal in the same bath for half-an-hour. Desiring a more constant temperature (for you cannot keep it exact with lead), I subjected the two coals to the heat of boiling mercury, which is quite precise, 662°. I found at this temperature, at which the water came freely off, a distinct eupyreumatic smell; and on the watery distillate, I saw with a magnifying glass solid crystals, which I presumed to be paraffine, but they were too small to examine. The total loss of weight, including the water, was 4 per cent., and the whole product was miscible with new water, showing that no oil was produced. I then put my retorts into a temperature at which zinc just melts—773°. At that temperature more water came off, and now some drops of oil, but not enough to escape from the neck of the retort. I now heated up the sand-bath until it became faintly luminous in the dark, and at this temperature boghead gave 30 per cent. and leeswood 23 per cent. of crude oil. The crude oil of course contained a little water. The temperature was a low red heat—980° according to Miller's tables. I did not define it; it would require a scientific investigation by myself to do so. The result of these experiments is that there is no practical distillation up to 773°. I tried carefully to get a heat between 773° and a low red, but did not succeed. The lowest temperature at which a practical distillation can take place is between 800° and 1000°; I cannot say nearer. In both the experiments mentioned the oil obtained was saturated with paraffine, and became semi-solid on standing. There is nothing in Lord Dundonald's patent to indicate Mr. Young's process; nor in Reichenbach's papers to indicate the process in a commercial sense. I never saw paraffine which was obtained from coal until after Mr. Young's patent, nor do I recollect seeing it from schist.

Cross-examined by Sir Fitzroy Kelly: Before the date of Young's patent it was known that oil could be obtained from bituminous coal by distillation, and that the oil contained paraffine. It was known also that more oil was obtained at a low temperature, and gas and naphthaline beyond a red heat. It was known at the date of the patent that an oil could be produced from coal, but it was not known, to my knowledge, that it contained paraffine oil. It was known that the oil contained paraffine, but paraffine oil is a distinct substance—paraffine which is permanently in a liquid state. Reichenbach's product was tar mixed with a small quantity of paraffine; Mr. Young's paraffine oil not containing tar. In the description of Genssane's process in Morand's work the words "slightly red" may be read a "low red heat." This description of the heat does not substantially differ from that in Mr. Young's specification. The product which passed into Genssane's receiver was a bitumen used for burning and for greasing cart wheels. I do not believe it was the same as Mr. Young's crude oil. I believe it was tar containing a good deal of paraffine. The oil passed off by the vertical pipe near the retort, intended to carry off what Genssane calls "sulphur." That "sulphur" I believe to have been chiefly the volatile products. The difference in the products I ascribe to the difference in the condensing apparatus. If Mr. Young's present apparatus had been adopted there would have been a large proportion of Mr. Young's crude oil. I called Genssane's product tar. Tar is used as an oil for burning in miners' lamps, but it is a very smoky oil. Undoubtedly it was a novelty to obtain an oil containing paraffine from bituminous coals. If Mr. Young had said a tar containing paraffine, there would have been nothing absolutely new. When he uses the term an oil containing paraffine, he indicates a liquid paraffine in which paraffine was in solution, and to the best of my knowledge that was new, both as a discovery in the arts, and as a discovery, so far as I know, not formerly described in science. It was not new to obtain tar containing paraffine; but it was new, in my estimation, to obtain an oil, in the sense in which Mr. Young uses it, containing paraffine. I have said before that it was not new to obtain an oil containing paraffine from bituminous coals. I showed Mr. Young's oil at the Royal Institution in 1852; it was "paraffine oil." I do not think the crude oil was ever burnt in lamps. There are three, perhaps four, substances made from the crude oil; first, naphtha, which is not used for burning, but only for purposes like turpentine; next, the portion which is used for burning; thirdly, the lubricating oil; and, lastly, paraffine. The burning oil is obtained after you have taken away the most volatile portions. [The witness was then examined on the processes of Lord Dundonald, De Hompesch, and Du Buisson, but this part of the examination offers nothing of importance, nor was anything of interest elicited in the re-examination by Mr. Grove.]

Sir Robert Kane (examined by Mr. Hindmarsh): The evidence of this witness was simply a confirmation of that of the two previous witnesses. In the cross-examination by Sir Fitzroy Kelly witness expressed an opinion that the original idea of Mr. Young's patent might be traced in a vague and misty way in Genssane's process, but the products of the process conducted according to Genssane's own directions would have no practical similarity to Mr. Young's, nor any commercial value for the same purposes.

The next witness examined was the plaintiff, Mr. J. Young, who in his evidence gave an account of the experiments which led to his taking out the patent in dispute. Subsequently the witness described his recent improvement of conducting the distillation in a vertical iron retort, cased in brick about a third of the way up, which is charged at the top, and the coke raked out at the bottom. The coals pass through this in three hours. A specimen of pure paraffine weighing about 60 lbs. was produced, and the witness said it would take about two tons and a-half of coal to produce that quantity. One ton of coals will produce over 100 gallons of crude oil; about one-third of which will be lost in refining. The paraffine is separated from the oil partly refined; it crystallises out and is separated by straining. Pure paraffine fetches one shilling a pound; and the refined oil is sold for 2s. 3d. a gallon.

Mr. Young was then cross-examined by Mr. Mackeson. In the course of the cross-examination, extracts from Nicholson's "Dictionary of Chemistry," 1795, and Macquer's "Dictionary of Chemistry," 1777, were produced, which showed that coal had at that time been submitted to distillation, and oils and petroleum obtained therefrom. The witness was then examined as to the resemblance of the apparatus he uses with that used by Reichenbach, who also used an iron retort cased in brick at the sides, so that the fire could only reach the retort at a part covered with coal. Reichenbach also adopted the precaution of applying the heat gradually up to a dull redness to avoid the production of napthaline. With regard to the nature of the coals employed, Mr. Young admitted that other besides Boghead coal was employed by him. A cannel coal from Wigan yielded the oils. At first 15s. 6d. per ton was paid for boghead; it has since sold for 45s.

Drs. Stenhouse and Odling were called to prove the identity of the defendant's oils with those of the plaintiff. The other witnesses were mining agents and geologists, whose evidence we need not notice. In our next we shall give the shortest possible statement of the case for the defendants, which will, however, be well understood from the Vice-Chancellor's judgment, which follows:—

JUDGMENT.

The Vice-Chancellor: The main objection to the validity of the plaintiff's patent is, that both as to the process and material there is nothing new; and that the specification indicates nothing which was not publicly known and publicly used before the date of the patent.

It appears, from the evidence, that for very many years before the discovery of the substances now called paraffine and paraffine oils, the distillation of coals and bituminous substances, at every variety of temperature, had been well known and practised for the production of tars and oils which had been used for lubrication of the ruder kinds of machinery and for burning. It is certain that the discoveries by Reichenbach of paraffine, naphthaline, and various other distinct substances, as products from the carbonisation of animal tar, vegetable tar, and coal tar, about the year 1832, were hailed by men of science as important discoveries. In one passage of his writings, as printed in the Extracts before the Court, Reichenbach says:—"There must necessarily be several ways and means of getting at a body of so strong a constitution as paraffine, when mixed up with others so easily decomposed as those which we will for the present consider under the collective denomination of empyreumatic oils. I have come upon the track of some of these; others, perhaps better ones, the future will discover."

It is certain that Reichenbach, although he ascertained the existence of paraffine in coal, did not indicate coal of any kind as the material capable of producing paraffine or paraffine oils in most abundance. There is ample evidence that the attention of practical chemists was previously to the date of Young's patent laboriously directed to discover the proper material and the proper means of producing these articles in sufficiently large quantities for commercial purposes. Amongst others, Hompesch's patent was obtained in 1841 for obtaining oils from schist or clay slate and asphalte; and his memorandum of alteration is made for the purpose of confining it to "other rocks or minerals containing bitumen or bituminous substances." Du Buisson's patent, granted in 1845, is remarkable for its recital that in England all attempts to make bituminous schistus useful had failed. His specification claims a particular apparatus and process, and it states that the presence of paraffine is scarcely perceptible in bituminous stone, asphalte, or other bituminous mineral substances, and that it is in schistus that it is contained in the largest proportion.

There is no evidence of any specification, of any patent, or any publication in which cannel coal, or coal which produces olefiant and other highly illuminating gases in considerable quantity, was indicated as the class of materials, among the wide range of animal, vegetable, and mineral substances, which, subjected to a proper process, would produce paraffine and the oils called by Young paraffine oils in large quantities, so as to create a manufacture for commercial purposes, till Young's specification was published. Cannel coals had been tried by many, but without success. Among the many practical and manufacturing chemists who had been vainly attempting to find out how to manufacture paraffine oils and paraffine so as to supply the market, none had been fortunate. The fair result of the immense load of evidence in this case shows the prevailing opinion to have been, that not coals of any kind, but shales or schists properly so called, were the best material. The witnesses of the defendants give evidence which seems convincing on this subject.

Mr. Kirkham, a practical and manufacturing chemist, has proved that from the year 1845 he had been making experiments on what he calls crude oil, and the distillation of various kinds of coals, including cannel coals, at a temperature of something like 700 degrees of Fahrenheit, for the purpose of ascertaining what oil they would produce; but that he could not succeed in getting quantities of oil from these various kinds of coal of any commercial value, although he distilled in large quantities. The results he obtained from cannel coals he found little better than from Newcastle coals. This witness who states these facts states also with perfect confidence that there is nothing new in Young's specification, and nothing described in it which he did not know before. This statement is true in this sense, that it was well known that coals, cannel coals, as well as every other animal, vegetable, or mineral production, could be distilled at any temperature within a very wide range, and would produce paraffine and paraffine oils. But it is not true, in this sense, that he knew before he read Young's specification, which class of substances, among many, and which temperature in a wide range, and which process, among many, would supply the commercial world and the public with a class of paraffine and paraffine oils which so many were in vain seeking to supply, till the manufacture of Young had supplied it. From the evidence of this witness and the evidence of Fisher, a practical and manufacturing chemist, and the evidence of Parkes, a very intelligent witness, it appears, when accurately weighed, that these persons, like many others, were unsuccessfully attempting to manufacture paraffine oils and paraffine for commercial purposes. Fisher, in particular, seems to have been working for years extensively to produce paraffine oils of a quality to supply the market. He distilled shales and coals of various kinds, including boghead itself, in considerable quantities. He states that he was largely engaged in the manure trade, and has had by him as many as 1000 or 2000 gallons of oils, produced, as he says, from "coals, shales, cannels, and different things." He supplied the other witness, Parkes, with oils, out of which he extracted paraffine; and, according to Parkes' statement, the total amount supplied to him at various times during several years was not less than 100 gallons altogether.

Parkes also was engaged in experiments as to the production of burning oils and paraffine from shales and coals, with a view to perfect a manufacture, for which, if he could have succeeded, he says he wished to obtain a patent. Experimentally he had gone so far as to produce small pieces of candle and night lights. This witness, who seems an intelligent person, employed Fisher, and gave him instructions and suggestions as to the distillation of shales, and coals, and cannels for the production of paraffine oils. But it is needless to go farther than this evidence produced by the defendants of these three persons, Kirkham, Fisher, and Parkes, the most important practical witnesses of the defendants, for clear proof that they, like so many others, were laboriously endeavouring to effect, and entirely failed in effecting, the discovery made by Young. They did not discover that cannel coals and other coals which yield olefiant and other highly illuminating gases were the proper material.

The completeness of the failure is demonstrated by two facts—first, that the oils sent by Mr. Fisher to the Great Exhibition of 1851 were rejected and refused a place on account of their objectionable quality and offensive smell; and second, that after Young's patent, in Fisher's correspondence with a person named Clift, it is stated by the latter that Young could not make the oil so good from coals, and would direct his attention to the native bitumens; and a question is asked as to whether Fisher would work his retort beyond a cherry red.

This correspondence is in May 1851, and it affords ample evidence that the material, and the process, and the temperature indicated by Young were not those used or practised by them.

Each of these three witnesses, like most of the others for the defendants, says that Young's specification contains nothing new. No doubt this is true in the sense which I have already distinguished. But it is not true in the sense in which the law requires that the word "new" should be used and understood on the question to be decided in this cause. Mr. Parkes states that he was asked by Mr. Fisher to go to Scotland as a witness against the plaintiff Young, in an action in which the validity of the patent was contested on grounds similar to the most material in the present case; but he declined to go, for this good reason, that he considered Young ought to succeed as the first public introducer of the manufacture.

Turning now to the men of science who have supported the defendants' case by their testimony: Dr. Alfred Swaine Taylor stated that the amount of olefiant gas is no criterion of the quantity of paraffine that any particular coal will yield. But in his cross-examination he admitted that he did not examine the quantity of olefiant gas in the coals, and that he had made no experiments as to whether coals yield olefiant gas in the same ratio as paraffine. He admits that he was not aware before Young's patent that paraffine could be extracted from coal in merchantable quantities. He says that, although he knew paraffine was extracted from coal, yet Young's patent process came upon him as a novelty, and that it was a new thing to hear of it in the quantity which Young produced.

Dr. Anderson, who is another of the defendants' important scientific witnesses, is remarkable for his change of opinion on the question of novelty. He was one of the witnesses for Mr. Young in the Scotch cause. His report made with reference to that case is at variance with his evidence now given. He has stated the cause of his conversion to be the knowledge he had since acquired by what he had read of Selligue's works, and in the specification of Happey's patent, and in Black's "Elements of Chemistry." When these writings are looked at, his reasons and explanations as to his change of opinion appear to be so very lame that the value of his evidence is reduced to a low degree.

He and the other scientific witnesses, together with workmen and others who gave evidence, and a narrative of experiments on the questions of temperature and materials, seem to me to have afforded no real assistance to the defendants' case.

Experiments conducted for the express purpose o manufacturing evidence for this cause are to be looked at with distrust.

As to the many witnesses produced to prove that boghead coal is a "shale;" that all cannel coals are shales; that Kimmeridge shale is coal; that Leeswood curly cannel coal is not a shale, although other cannel coals are shales; that the manufacture of offensive and unmarketable oils from Kimmeridge shales was a manufacture of Young's oils and an anticipation of his invention; that the tar and coke ovens used in South Wales to produce a coarse tarry oil, used for lubricating the wheels of tram-waggons, was an anticipation of Young's lubricating paraffine oils; all the immense mass of evidence which the defendants have laid before the Court on these various points failed to produce any serious effect upon my mind towards establishing the case of the defendants, and a reconsideration of it satisfies me of its unimportance.

On the question of temperature, as described in Young's specification, there has been in the evidence and arguments on behalf of the defendants some confusion between the heat applied to the outside of the retort and the heat of the materials within. There has been a great conflict of evidence, but the result of a careful review and estimate of the evidence leaves my mind satisfied that Young's specification has given the proper directions and described the proper gradation and limit of the temperature, up to, and not exceeding, a low red heat on the outside of the retort, for producing paraffine oils and paraffine in the greatest abundance which has yet been obtained.

On the question of infringement, as well as with reference to the validity of the patent, the defendants have laboured to show by evidence that a temperature lower than a low red heat, and therefore not according to Young's specification, is that at which they have worked, and is the best temperature for producing paraffine oils and paraffine in the greatest quantity and of the best quality. Their evidence has entirely failed to establish the fact that they have not used for their manufacture the same class of coals, and the same gradation and limit of temperature which Young describes; or that a gradation and limit of temperature lower than Young's is the best. The evidence remains unshaken on this point, and on the other main points of the case the evidence of the plaintiffs' witnesses has been clear and strong, and greatly outweighs that of the defendants.

In dealing with the case it has seemed to me better to direct attention to what has been said by the witnesses of the defendants.

One of these, Dr. Taylor, admitted that there are many chemical substances produced, not in abundance, but in small quantities, which, if they could be produced in large quantities, so as to be merchantable commodities, would be highly valuable. This is the proposition which seems to be at the root of the plaintiffs' case. In the case of monopolies, Lord Coke says that all monopoly patents were void both by common law and the statute, unless they were granted to the introducer of a new trade or engine. The words of the statute of James the First are, "the sole working or vending of any manner of new manufactures within this realm to the true and first inventor and inventors of such manufactures."

Mr. Fernie, one of the defendants, has adduced in evidence a passage from the work of an eminent American chemist, Dr. Antisell, who holds an important position in the Patent Office of the United States of America. It appears that the plaintiff Young has obtained a patent in the United States for his manufacture. This book contains a short history of the manufacture of paraffine oils and paraffine; and it gives the following extract from a publication by Reichenbach in 1854:—"So remained paraffine until this hour a beautiful item in the collection of chemical preparations, but it has never escaped from the rooms of the scientific man." Something, therefore, remained to be ascertained, in order to the useful application of this article for economical and commercial purposes. This illustrates the important distinction between the discoveries of the merely scientific chemist and of the practical manufacturer who invents the means of producing in abundance, suitable for economical and commercial purposes, that which previously existed as a beautiful item in the cabinets of men of science.

What the law looks to is the inventor and discoverer who finds out and introduces a manufacture which supplies the market for useful and economical purposes with an article which was previously little more than the ornament of a museum.

It has been established to my satisfaction, by the evidence in this cause, that the plaintiff Young is an inventor of this class, and that his patent is entitled to the protection of the law. I find that he has ascertained, by a course of laborious experiments, a particular class of materials among many, and a particular process among many, which has enabled him to create and introduce to the public a useful manufacture, which amply supplies the market with that which, until the use of the materials, and process, and temperature indicated by him, had never been supplied for commercial purposes. At the date of his patent something remained to be ascertained which was necessary for the useful application of the chemical discovery of paraffine and paraffine oils. This brings it within the principle stated by the Lord Chancellor in the late case of " Hill *v.* Evans. The manufacture, with the materials and process indicated by him, according to the sense in which I understand the word "manufacture" to be used in the statute, was a new manufacture, not in use at the date of his patent.

The principle upon which the present case should be decided is, to my mind, so clear, that it is unnecessary to examine the cases cited by the defendants' counsel. Inventions in mechanics are as widely different from inventions in economical chemistry as the laws and operations of mechanical forces differ from the laws of chemical affinities, and the results of analysis and experiment in the comparatively infant science of chemistry, with its boundless field of undiscovered laws and undiscovered substances. This observation, as applied to reported cases, will strike the mind of every lawyer who has even a slight elementary knowledge of both sciences. But if it had been necessary to examine the authorities, there are to be found in them some propositions as to what amounts to a publication, and whether the use of a lock of peculiar and improved construction upon a gate is notice to the public of the nature of the improvement, which would, perhaps, deserve serious consideration. It is not, I think, the habit of mankind to go about examining the construction of the locks on their neighbours' doors or gates. Even the few men endowed with an honest curiosity in examining mechanical inventions would probably not be anxious to be found taking models of their neighbours' locks, or prying into the exact construction of fastenings intended to protect private property against the whole body of the public.

But whatever may be the correct view of the law on that subject, the principle which seems to me to govern the present case is broad and clear. Twice already has the validity of this patent been established before tribunals of high authority. First, before the Lord Chief Justice of England and an English jury; next, before the Lord President of the Court of Session in Scotland and a Scotch jury. All the most important parts of the evidence before me were laid before these tribunals. I recognise in the Lord President's charge to the jury a just view of the law. If my own mind had not been well satisfied upon it, I should have hesitated long before I ventured to dissent from these two decisions.

The conclusion is, that I find in favour of the plaintiffs upon all the four issues, and there must be a decree in favour of the plaintiffs, with costs to be taxed and paid by the defendants.

Fatal Explosion of Gun-cotton.—We regret to have to announce that a serious explosion occurred last week at the gun-cotton manufactory of Messrs. Prentice and Co., Stowmarket, Suffolk, which has resulted in the death of one of the female employées, and placed in jeopardy the lives of four other persons, including the foreman of the works. The coroner's jury have been unable to determine the precise cause of the disaster, and recommend the immediate appointment of a scientific commission to inquire into all the circumstances, with a view to prevent the recurrence of similar accidents. It is known that the operation of cutting the gun-cable into short lengths of about six inches, by means of a steel blade worked by machinery, was the primary cause of danger in this instance, and it is supposed that some particles of a gritty nature accidentally coming in contact with the knife had developed sparks or a sufficient degree of heat to ignite some portion of the material, and that the flame quickly spread to the whole cable (about ten feet in length) which was at the moment lying exposed in the immediate vicinity of the cutting machine.

ANSWERS TO CORRESPONDENTS.

Vol. VIII. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. VIII. commenced on July 4, 1863, and will be complete in 26 numbers.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

W. L. C.—See the *Comptes Rendus* of the date mentioned. The translation will appear in a week or two.

T. N.—The writer is anxious to acquire chemical instruction, particularly of a technical kind, by corresponding with any one who will aid him.

G. J.—1. In the War Department and at the Mint. 2. Through the heads of the departments.

N. J.—Carbonate of lead is soluble in nitric acid, sulphate of baryta is not.

Silicium.—On the large scale it is made on the hearth of the reverberatory furnace. Various kinds of sand are used, but oftener than either, flints first made red hot, then quenched with cold water, and afterwards ground to powder.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Classification of the Elements in Relation to their Atomicities, by Professor A. W. WILLIAMSON, *F.R.S., President of the Chemical Society.*[*]

THE object of Professor Williamson's paper was to show the chemical reasons for considering that the atomic weights of all the metals should be doubled, except the alkali metals, gold, silver, boron, and the metals of the nitrogen series. Cannizzaro argued some years ago in favour of this conclusion from a consideration that the atomic heat of these metals is just about half as great as that of gold, silver, antimony, phosphorus, &c. He proposed to remove the discrepancy by doubling the atomic weights of the heavy metals, the metals of the alkaline earths, &c., so that the product of the atomic weight with the specific heat of each of them should be equal to the product of the atomic weight of potassium by its specific heat, or of silver or antimony, &c. The chemical reasons for this change were argued to be of precisely the same kind as those which had already decided chemists to adopt for oxygen the atomic weight 16, and for carbon the atomic weight 12. The question, however, involves a general classification of the elementary bodies.

The author gave an outline of the analogies which connect chlorine, bromine, and iodine, equality of vapour-volume in the free state, the molecule of each of these elements containing two atoms in the same volume as that occupied by H_2, now generally called two volumes; the analogy of their oxygen compounds, the mono-basic character of the hydrides, the isomorphism of many of their corresponding salts, &c.

Very similar considerations are admitted to prove that oxygen, sulphur, selenium, and tellurium are analogous to one another in their general chemical properties and in the constitution of their similar compounds.

But each atom of oxygen, sulphur, &c., combines with two atoms of hydrogen, and is equivalent to two atoms of chlorine or bromine, &c., for if two volumes of steam, H_2O, or of alcohol vapour,

$$H(C_2H_5)O + PCl_5 = HCl + (C_2H_5)Cl + POCl_3.$$

When chlorine acts on hydrogen compounds it takes out one, two, or three hydrogen atoms, putting in an equal number of atoms of chlorine, thus:—

$$\underset{\text{Acetic acid.}}{C_2H_4O_2} + Cl_2 = \underset{\text{Chlor-acetic acid.}}{C_2H_3ClO_2} + HCl.$$

Whereas when oxygen re-acts on a hydrogen compound it takes out two atoms of hydrogen, replacing them by one of oxygen—

$$\underset{\text{Alcohol.}}{C_2H_6O} + O_2 = \underset{\text{Acetic acid.}}{C_2H_4O_2} + H_2O\,;$$

or it takes out four atoms of hydrogen, putting in two of oxygen, and so on; never an uneven number of atoms of hydrogen replaced by oxygen in one molecule.

The replacement of oxygen by sulphur produces no change of atomicity or of vapour volume.

The family of the five elements—nitrogen, phosphorus, arsenic, antimony, and bismuth—is also well known and universally admitted.

The analogous basic hydrides, or ethylides, on the ammonia type, are decisive of the analogy of the elements, but beyond them we have the series of acids analogous to nitrous acid and to nitric acid, and many isomorphisms.

The alkali metals, including lithium, rubidium, cæsium, and thallium, as well as silver, are eminently monatomic, for they all replace hydrogen atom for atom They form no basic salts. Their sulphates form with sulphate of alumina those characteristic salts called alums. Gold is monatomic in its protochloride, but triatomic in its common solution. Boron appears usually to be triatomic, as the constitution of its chloride and of its ethylide admits of no other formula. Carbon and silicon are usually tetratomic, but sometimes biatomic.

The remaining metals present so great a variety of properties that their classification is only effected by establishing among them some natural families, and connecting each family in succession with the biatomic or tetratomic elements. Thus magnesium, zinc, and cadmium form a well marked family of metals, all volatile, and forming very similar salts, and zinc is clearly proved to be biatomic by the constitution and properties of zinc, ethyl, $Zn(C_2H_5)_2$, which occupies the same vapour volume as ether, $O(C_2H_5)_2$.

Half the ethyl can be taken out of zinc ethyl and replaced by iodine without breaking up the molecule $Zn(C_2H_5)I$. The oxides of these metals have, therefore, the formulæ MgO,ZnO,CdO, while the chlorides are $MgCl_2,ZnCl_2,CdCl_2$, and the nitrates are $Mg(NO_3)_2$, &c.

Then, again, calcium, strontium, barium, and lead present in their salts many striking points of analogy, and abundant cases of isomorphism. The compounds $Pb(C_2H_5)_4$ and $Pb(C_2H_5)_3Cl$ prove lead to be tetratomic in its brown oxide, PbO_2, and biatomic in its common chloride, $PbCl_2$, and nitrate $Pb(NO_3)_2$, and we are, by analogy, led to extend the conclusion to the other metals of the family. The analogy and isomorphism of some lime salts, &c., with the corresponding salts of magnesia, would lead independently to the same conclusion. Carbonate of lime has thus the formula $CaCO_3$, which is so much like the formula of nitre, KNO_3, that our surprise is removed at the isomorphism of arragonite with the latter salt, or at that of nitrate of soda and calc spar.

Then iron, aluminium, chromium, and manganese form analogous and isomorphous sesquioxides which are capable of replacing one another in the alums; so that the metals must have a similar atomicity. Chromium is proved beyond dispute by the constitution of chlorochromic acid to be biatomic like sulphur, which forms the corresponding compound—chloro sulphuric acid; the conclusion is confirmed by the analogy and isomorphism of the sulphates and chromates. Chromium thus brings iron, aluminium, and manganese over with it to the class of even-atomicity metals. But manganese, from the properties of the manganates, would prove the same thing independently, and again in permanganate of potash, MnO_4K, the atom of manganese replaces the atom of chlorine in perchlorate of potash ClO_4K.

Nickel, cobalt, and copper are, moreover, known to form a variety of salts so analogous in constitution and crystalline form, &c., to the corresponding salts of iron, manganese, lime, and magnesia that their protoxides have been long designated as the magnesian family, and must be represented by biatomic formulæ such as $CuO,CuCl_2$, &c.

Then mercury in its higher chloride and the corresponding ethylide is undeniably biatomic, as tin is biatomic in its lower chloride $SnCl_2$, and tetratomic in its liquid chloride, and in the corresponding ethylide $Sn\,(C_2H_5)_4$.

Considerations of analogy serve to extend the conclusions to the remainder of the heavy metals, and to class them all with oxygen, and carbon, &c., as elements of

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[*] Abstract of a discourse delivered before the Chemical Society, May 19, 1864. Communicated by the Author.

even-atomicity, or, as Dr. Odling proposes to call them, "artiads."

The conclusion of the paper was occupied by a consideration of various apparent objections to these general conclusions. Mercury and cadmium are known to have a vapour volume corresponding to one atom of each in the molecule of two volumes, but so have CO,SO_2, and C_2H_4.

Phosphorus and arsenic have four atoms in each molecule of vapour, being, doubtless, built up on the ammonia type. The sesquichlorides of iron, aluminium, and chromium are found to contain Fe_2Cl_6, &c., each molecule of vapour proving that these metals in their sesqui-salts still have an even number of "perissad" atoms in each molecule. The basic nitrate of lead, $PbNO_3HO$, had been quoted in proof of the biatomic character of that metal, and the corresponding salt of mercury extends the conclusion to it.

In its subsalts mercury also forms basic compounds, which cannot be accounted for if the metal is there really monobasic like potassium. The basic subnitrate of mercury, Hg_2NO_3HO proves for it exactly the same thing which the vapour volume of the sesquichlorides proves for them—viz., that their subsalts are no exceptions to the law of even-atomicity for these metals.

On Some New Double Salts of Chromic Acid, and their Photographic Applications, by M. E. Kopp.

The starting point of these researches was an unsuccessful attempt to prepare ammonic chromate.

I tried to obtain this salt by dissolving an equivalent of bichromate of potash in caustic ammonia, and adding to the concentrated solution a boiling solution of one equivalent of ammonic sulphate. I hoped that slightly soluble sulphate of potash would be deposited, and that neutral ammonic chromate would remain in solution.

But if concentrated liquids are used, masses of double chromates are formed, crystallising in needles, crusts, &c., in the midst of the sulphate of potash; and if the solutions are diluted, too much of the latter salt remains in solution.

Having isolated a certain quantity of crystals in needles, it became easy to ascertain that they constituted a double chromate of potash and ammonia, and it was interesting to further examine this salt, which has not yet been described.

Double Chromate of Potash and Ammonia.—By finely pounding bichromate of potash with concentrated caustic ammonia we get a straw-coloured magma, whilst the ammonia is in excess; on being left in contact with the air, the ammonia disappears, and the mass takes a gradually deepening orange tint.

By dissolving with heat bichromate of potash to saturation in caustic ammonia, a large quantity of ammoniacal gas is disengaged by boiling, and on cooling there is generally obtained a mixture of crystals, some yellow and others orange.

The following is the best method for preparing pure double chromate of potash and ammonia:—

First obtain, by several re-crystallisations, some perfectly pure bichromate of potash. Introduce a certain quantity of this salt into a sufficiently strong spherical flask, and into it pour pure and concentrated liquid ammonia, shaking constantly until the strong and persistent odour of ammonia indicates an excess of volatile alkali.

Stopper the flask well, and heat it in a water bath until the contents are completely dissolved. On cooling the double salt crystallises in abundance and in a perfectly pure state. Open the flask, decant the mother liquor, and dry the crystals under a receiver over quick lime, and in a slightly ammoniacal atmosphere.

Under rapid crystallisation double chromate of potash and ammonia crystallises in long, fine, and transparent needles of a light sulphur colour, or in four-sided prisms, apparently with rhomboidal base, the summits of which are frequently feather-edged, in consequence of the replacing of one or two edges by inclined facets.

By slow crystallisation of not too much concentrated liquids after slow cooling, sufficiently bulky crystals are obtained.

The mother liquors of crystals left to evaporate slowly under the receiver did not give very distinct and well-defined crystals, on account of the tendency of the salt to accumulate along the sides.

The same mother liquors left in contact with the air in a precipitating vessel, covered with paper, gave a bulky sulphur-coloured efflorescence, containing both potash and ammonia, and at the bottom of the liquid orange-coloured crystals of bichromate of potash.

Double chromate of potash and ammonia contains no water of crystallisation. The formula of the salt is $CrO_3,KO + CrO_3,NH_3,HO$.

One gramme of the salt dissolved in water containing acetic acid, precipitated by acetate of lead, gives a precipitate of chromate of lead, which, washed and dried at 100°, weighs 1 gr. 870, corresponding to 57·97 per cent. of chromic acid. A slight excess of sulphuric acid is added to the washings, which are then evaporated to dryness, recovered by water, filtered, and again evaporated to dryness in a crucible; after calcination at red heat, and the occasional addition of morsels of ammonic carbonate, a residue of sulphate of potash remained weighing 0 gr. 500, corresponding to 27.04 per cent. of anhydrous caustic potash.

In a second analysis 1 gramme of a salt of another preparation (which had probably already lost a little ammonia) furnished 1 gr. 88 of chromate of lead, corresponding to 58·28 per cent. of chromic acid.

The formula $CrO_3.KO + CrO_3NH_3HO$ requires ($O = 100$).

		Calculation.	Experiment.	Experiment.
$2CrO_3$	1256·00	57·88	57·97	58·28
KO	589·00	27·15	27·04	
NH_3	212·50	9·79		
HO	112·50	5·18		
	2170·00	100·00		

The formula $Cr_2O_6.KO + H_3N$ would require 61·04 per cent. of chromic acid, and the formula

$$Cr_2O_6.KO + H_3N + 2HO,$$

would correspond to 55·03 per cent. of CrO_3.

Properties of Double Chromate of Potash and Ammonia.—On exposure to the air, the salt gradually loses its ammonia and acquires an orange tint. The decomposition is remarkably retarded when the salt retains no more ammonia than corresponds to a potassico-ammonic sesquichromate.

Heated very gradually, the salt loses all its ammonia, finally leaving a red salt, which is fused bichromate of potash.

Heated rapidly, a certain quantity of chromic acid is reduced, and water is formed at the expense of the ammonia.

The solution of the salt, evaporated or boiled for a long time, also loses its ammonia, and is converted into a solution of bichromate of potash.

This property of double chromate of potash and ammonia of losing its ammonia by dessication and vaporisation, leaving an acid salt as residue, and consequently containing nearly free chromic acid, makes it probable that it may be usefully applied in the arts, and among others to calico printing.

In fact, the more neutral the salt the more feeble comparatively are its oxidising properties; but they become more and more evident as the ammonia is disengaged, and reactions then take place, a few of which we will proceed to describe.

In this way, for instance, alkaline hyposulphites, phosphorus, etc., can remain for an almost indefinite time in contact with a neutral solution of alkaline chromate without the occurrence of any reaction; but as soon as the chromate changes to bichromate the chromic acid is reduced, and the bodies capable of absorbing oxygen are oxidised.

It is often advisable to add to the potassico-ammoniacal chromate an equivalent of ammoniacal chloride, sulphate, nitrate, ammonic phosphate, for the purpose of converting all the chromic acid into ammonic chromate, the potash combining with the acid of the ammonic salt.

In the same way neutral potassic chromate may be used, or potassic bichromate saturated with soda ($Cr_2O_6.KO + NaO$), to which a proportional quantity of ammonic salt may be added, then after double decomposition the mixture may be considered as formed of a salt of potash or soda and of ammonic chromate; but the double salt of which we are treating will always have the advantage of introducing the smallest possible amount of inert potassic or sodic salts into the colour or into the reaction produced by the reduction of chromic acid. The results of a series of experiments—made, it is true, only on a small scale—favour the opinion that the use of potassico-ammonic chromate, or of mixtures similar to those above described, will be found equally advantageous on a large scale in the preparation of colours which require oxidation for the development of the full richness of their tints, such as the colours with base of dye wood, as log-wood, Brazil wood, Japan earth, tannin, aniline, toluidine, phenol, naphthylamine, &c.

(To be continued.)

Researches on Silico-Tungstic Acids,
by M. C. Marignac.

By boiling, with gelatinous silica, the solution of an acid tungstate of potash or soda, a certain quantity of silica is dissolved, the liquid takes an alkaline reaction, and contains an acid in which 1 equivalent of silica is combined with 12 equivalents of tungstic acid ($SiO_2 12WO_3$), and which I name silico-tungstic acid. This is an energetic and very stable acid, easily extracted from its salts, forming two hydrates in magnificent crystals, and most of its salts, which are very soluble, crystallise well.

Acid tungstate of ammonia forms, under similar circumstances, another acid, in which 1 equivalent of silica is combined with 10 equivalents of tungstic acid ($SiO_2 10WO_3$); this I call silico-decitungstic acid. It is much more difficult to extract this acid from its salts in a pure state; it forms an uncrystallisable hydrate, drying into a vitreous, brittle, very deliquescent mass. The extreme solubility of most of these salts renders their crystallisation difficult; they are, moreover, unstable.

Silico-tungstic acid has itself very little stability is almost impossible to dry without decomposing it. A very small quantity of silica is separated, and a new acid is thus obtained in which silica and tungstic acid are present exactly in the same proportions as in silico-tungstic acid, but differing from it in every respect; to this I give the name of tungsto-silicic acid. It forms a very soluble, and even slightly deliquescent hydrate, but from it may be obtained voluminous and perfectly determined crystals. It also forms a series of salts, which, though isomeric with silico-tungstates, differ from them in crystalline forms and in the proportions of water of crystallisation.

They seem in general more soluble than silico-tungstates (which are highly soluble) but less so than silico-decitungstates.

These three acids are quadribasic, considering as neutral those salts with 4 equivalents of base which are always formed when they are made to act on carbonates. The most frequent salts are those with 2 or 4 equivalents of base; the first generally crystallise most easily. As might be supposed from their polybasic nature, these acids have a strong tendency to form double salts. Thus ammonia does not precipitate a solution of silico-tungstate of alumina; but, on the contrary, alumina, as well as magnesia, carbonate of lime, &c., easily dissolves by boiling in a solution of silico-tungstate of ammonia.

Alcohol dissolves these acids quite as well as water. Perfectly anhydrous ether has a great affinity for them, and liquefies them, forming a syrupy, limpid liquid, insoluble in an excess of ether, miscible, on the contrary, in any proportion with cold water; but under heat the liquid becomes troubled, and the ether separates.

The salts of these acids being very soluble, and containing a very considerable proportion of tungstic acid, form solutions remarkable for their density—for instance, the solution of neutral silico-tungstate of soda, the density of which is 3·05; so that glass, quartz, and most stones float on this liquid, which is, however, very fluid.

Silico-tungstic acid crystallises at the ordinary temperature in large octahedral squares, the angles of which differ but little from those of the regular octahedral, containing 29 equivalents of water of crystallisation, according to the formula—$SiO_2 12WO_3 4HO + 29Aq$.

It begins to fuse towards 36°, and is completely liquified in its water of crystallisation at 53°.

When it crystallises at the ordinary, or a rather higher temperature, in presence of alcohol, hydrochloric, or sulphuric acid, it forms a hydrate containing only 18 equivalents of water of crystallisation. Then it presents the appearance of cubo-octahedral crystals; but this effect is really produced by the combination of two based rhombohedrals.

Dried at 100°, this acid retains, besides the combined water, 4 equivalents of water of crystallisation. Heated to 220° it not only loses these latter, but retains only 2 equivalents of basic water, which alone seem necessary to the formation of this acid. These it retains up to 350°, undergoing no alteration at this temperature. In this state it becomes strongly heated by contact with water, re-dissolves and re-crystallises without undergoing any change. Not till near red heat is the rest of the water expelled; at the same time the acid becomes yellow and insoluble, decomposing, probably, into a mixture of tungstic and silicic acid.

Tungsto-silicic acid crystallises with 20 equivalents of water of crystallisation, according to the formula—

$$12WO_3SiO_2 4HO + 20Aq.$$

These crystals belong to the system of non-symmetrical oblique prisms. In humid air they become deliquescent.

On decomposing this acid by heat it undergoes the same changes as silico-tungstic acid. It possesses the same stability; boiling with acids, evaporation to dryness with aqua regia, fail to determine its decomposition.

I have applied myself to the crystallographic study of many of the salts of these acids. My studies have not led me to any curious relation to other combinations, since these acids seem to belong to a new type of compounds. However, comparisons between the forms of a certain number of these salts give some interesting results. During my examination I was struck with the incontestible analogies of form between compounds of which it is difficult to admit the isomorphism. Thus the forms of acid silico-tungstates of baryta and lime are identical with those of free silico-tungstic acid crystallised with heat. It is true that the proportions of water of crystallisation are the same, so that they present a positive example of isomorphism of water with lime and baryta. But I find it impossible to admit this isomorphism, not only because no other example has ever been found, but more especially because it seems to be theoretically impossible, baryta and lime being the bases of a single atom of metal, while water contains 2 atoms of hydrogen.

Several other coincidences of forms, for instance, between salts of soda, entirely different in the proportions of their base and water of crystallisation, have led me to ascribe these facts to the intervention of a general cause, whose influence I do not, however, pretend to be the first to have observed, and also to a necessary extension of Mitscherlich's fundamental principle of isomorphism. It must, I think, be admitted that when two compound bodies contain an element or a group of elements in common, forming the greater part of their weight, these compound bodies may, from that cause alone, be isomorphous, even when the rest of the elements, wherein they differ, do not constitute a similar atomic or isomorphous grouping in the two compounds.

M. Scheibler's excellent memoir on metatungstates has already furnished a remarkable example of this principle, for he has established that most salts of this kind are isomorphous, though they contain very different proportions of water as to the number of atoms they represent, but which vary only between 12 and 15 per cent. of the total weight of these salts. Moreover, I believe that many of the coincidences of form observed between certain minerals whose atomic constitution does not seem to justify their being called isomorphous are ascribable to this simple cause, without having recourse to the more or less complicated systems devised by some mineralogists.

If, as I believe, this principle is true, we must henceforth exercise great reserve in assuming the isomorphism of two bodies from that of the complex compounds into which they may enter. It also proves how vain are the attempts made to derive the crystalline form of a compound solely from a consideration of the number of atoms of various elements entering into its composition.—*Comptes-Rendus*, lviii., 809, 1864.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read:—"On the Identity of Methyl and Hydride of Ethyl," by Dr. Schorlemmer; "On Vacuum Experiments," by Dr. Sprengel.

TECHNICAL CHEMISTRY.

Further Remarks on the Conversion of Salt Meat into Fresh by Means of Dialysis, by S. Johnson, *Esq.*

Seeing a note on this subject in the Chemical News May 28, by Mr. Whitelaw, I may be permitted to offer a few suggestions, which, perhaps, may prove of some value.

The question of utilising the carcases of animals killed for the sake of their skins in the colonies is one of great importance, as millions annually when stripped of their hides are thrown away, and are permitted either to decompose or become the food of beasts and birds of prey. Many of your readers, I am sure, have heard of the ingenious process for preserving meat, devised by Dr. Morgan, which was brought under the attention of the Society of Arts a short time ago. The invention consists in making use of the blood-vessels in the same manner as nature does when impelling the blood in the animal economy, displacing the blood, and substituting therefor an antiseptic liquid. By this means the meat is completely impregnated in a few minutes, for the liquid finds its way into the most minute ramifications of the veins, and consequently permeates the flesh as completely as the system of blood-vessels does; added to this, the membrane which forms the veins and arteries is an excellent dialytic medium, consequently the antiseptic substances soon dialyse through the membranes and tissues into the animal juices, thus curing the meat as perfectly as it can be done.

An idea which struck me forcibly on hearing an account of Dr. Morgan's invention is, that by reversing the process—that is, by dialysing the brine, &c., out of the tissues—the meat would be again made quite fresh. In order to accomplish this, a gentle current of water should be made to circulate the system of blood-vessels; in a short time, I have no doubt, by this treatment, but a mere trace of the antiseptic reagents would remain. The system of blood-vessels in this case corresponds to Mr. Whitelaw's dialytic bag. I may remark that of course it is necessary that the carcases of the animals be preserved entire, consequently this method of treating meat would have special reference to Dr. Morgan's process, which, without doubt, sooner or later, must come into general use.

In the case of introducing phosphates, &c., into the meat used on shipboard, for the purpose of supplying, to some extent, a want created by the absence of fresh vegetable food, as proposed by Dr. Morgan, the materials used should be introduced after the curing reagents have been removed.

It seems to me, also, that the objection to the curing of meat by means of creosote or phenic acid, which exists in the difficulty of removing the flavour, may possibly by this means be surmounted.

It may be interesting to remark that the contraction and expansion of the meat mentioned by Mr. Whitelaw, as due to the action of salt, is brought about by osmose.

10, Bonner's Road, Victoria Park.

Poison Bill.—Mr. H. Berkeley has given notice in the House of Commons that, on the 7th of next month, he shall ask leave to introduce a bill to amend the Act prohibiting the sale of poisoned seed, passed last session.

Simpson v. Holliday.—This important trial commenced on Wednesday, before Vice-Chancellor Page Wood. We shall give an abstract of the chemical evidence next week.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Thursday, May 26, 1864.

Professor W. A. Miller, *V.P., in the Chair.*

(*Continued from page* 270.)

A paper "*On the Spectra of some of the Fixed Stars,*" by W. Huggins, F.R.A.S., and Professor W. A. Miller, was then read. After a few introductory remarks, the authors describe the apparatus which they employ, and their general method of observing the spectra of the fixed stars and planets. The spectroscope contrived for these inquiries was attached to the eye-end of a refracting telescope of 10 feet focal length, with an 8-inch achromatic object-glass, the whole mounted equatorially and carried by a clock-movement. In the construction of the spectroscope, a plano-convex cylindrical lens, of 14 inches focal length was employed to convert the image of the star into a narrow line of light, which was made to fall upon a very fine slit, behind which was placed an achromatic collimating lens. The dispersing portion of the arrangement consisted of two dense flint-glass prisms, and the spectrum was viewed through a small achromatic telescope with a magnifying power of between 5 and 6 diameters. Angular measures of the different parts of the spectrum were obtained by means of a micrometric screw, by which the position of the small telescope was regulated. A reflecting prism was placed over one half of the slit of the spectroscope, and by means of a mirror, suitably adjusted, the spectra of comparison were viewed simultaneously with the stellar spectra. This light was usually obtained from the induction spark taken between electrodes of different metals. The dispersive power of the apparatus was sufficient to enable the observer to see the line *Ni* of Kirchhoff between the two solar lines D; and the three constituents of the magnesium group at *b* are divided still more evidently.[*] Minute details of the methods adopted for testing the exact coincidence of the corresponding metallic lines with those of the solar and lunar spectrum are given, and the authors then proceed to give the results of their observations. Careful examination of the spectrum of the light obtained from various points of the moon's surface failed to show any lines resembling those due to the earth's atmosphere. The planets Venus, Mars, Jupiter, and Saturn were also examined for atmospheric lines, but none such could be discovered, though the characteristic aspect of the solar spectrum was recognised in each case; and several of the principal lines were measured, and found to be exactly coincident with the solar lines. Between forty and fifty of the fixed stars have been more or less completely examined; and tables of the measures of about 90 lines in Aldebaran, nearly 80 in α Orionis, and 15 in β Pegasi are given, with diagrams of the lines in the two stars first named. These diagrams include the results of the comparison of the spectra of various terrestrial elements with those of the star. In the spectrum of Aldebaran coincidence with nine of the elementary bodies were observed, viz., sodium, magnesium, hdrogen, calcium, iron, bismuth, tellurium, antimony, and mercury; in seven other cases no coincidence was found to occur. In the spectrum of α Orionis five cases of coincidence were found—viz., sodium, magnesium, calcium, iron, and bismuth; whilst in the case of ten other metals no coincidence with the lines of this stellar spectrum was found. β Pegasi furnished a spectrum closely resembling that of α Orionis in appearance, but much weaker; only a few of the lines admitted of accurate measurement, for want of light; but the coincidence of sodium and magnesium was ascertained; that of barium, iron, and manganese was doubtful. Four other elements were found not to be coincident. In particular, it was noticed that the lines C and F, corresponding to hydrogen, which are present in nearly all the stars, are wanting in α Orionis and β Pegasi. The investigation of the stars which follow is less complete, and no details of measurement are given, though several points of much interest have been ascertained. Sirius gave a spectrum containing five strong lines, and numerous finer lines. The occurrence of sodium, magnesium, hydrogen, and probably of iron, was shown by coincidence of certain lines in the spectra of these metals with those in the star. In α Lyræ the occurrence of sodium, magnesium, and hydrogen was also shown by the same means. In Capella sodium was shown, and about twenty of the lines in the star were measured. In Arcturus the authors have measured about thirty lines, and have observed the coincidence of the sodium line with a double line in the star spectrum. In Pollux they obtained evidence of the presence of sodium, magnesium, and probably of iron. The presence of sodium was also indicated in Procyon and α Cygni. In no single instance have the authors ever observed a star spectrum in which lines were not discernible, if the light were sufficiently intense and the atmosphere favourable. Rigel, for instance, which some authors state to be free from lines, is filled with a multitude of fine lines. Photographs of the spectra of Sirius and Capella were taken upon collodion; but, though tolerably sharp, the apparatus employed was not sufficiently perfect to afford any indication of lines in the photograph. In the concluding portion of their paper, the authors apply the facts observed to an explanation of the colours of the stars. They consider that the difference of colour is to be sought in the difference of the constitution of the investing stellar atmospheres, which act by absorbing particular portions of the light emitted by the incandescent solid or liquid photosphere, the light of which in each case they suppose to be the same in quality originally, as it seems to be independent of the chemical nature of its constituents, so far as observation of the various solid and liquid elementary bodies, when rendered incandescent by terrestrial means, appears to indicate.

The next paper was "*A Comparison of the most Notable Disturbances of the Magnetic Declination in* 1858 *and* 1859 *at Kew and Nertschinck,*" by General Sabine. The titles of the following papers were afterwards read:—"*A Second Memoir on Skew Surfaces, otherwise Scrolls,*" Professor Cayley. "*On the Differential Equations which determine the Forms of the Roots of Algebraic Equations,*" Professor Boole.

CHEMICAL SOCIETY.

Thursday, May 19, 1864.

Robert Warington, *Esq., Vice-President, in the Chair.*

In continuation of our report of this evening's proceedings, we now give an abstract of the "*New Method of Gas Analysis,*" which has been elaborated conjointly by the President and Dr. Russell. The apparatus employed (of which we present a sectional sketch), was fitted up in the meeting room for the inspection of the Society, and its construction and use were very fully explained by Dr. Russell. The leading principle of this mode of analysis—wherein it differed at once from the methods of Bunsen, Regnault, and Frankland—was the dispensing with the barometer and thermometer, and the substitution of a standard volume of air with which the gas under examination was compared when brought, by very simple means, to the same pressure and temperature; and the advantages claimed for this method were increased rapidity and simplicity. The construction of the apparatus was described as follows:—A cast-iron mercury trough was formed with

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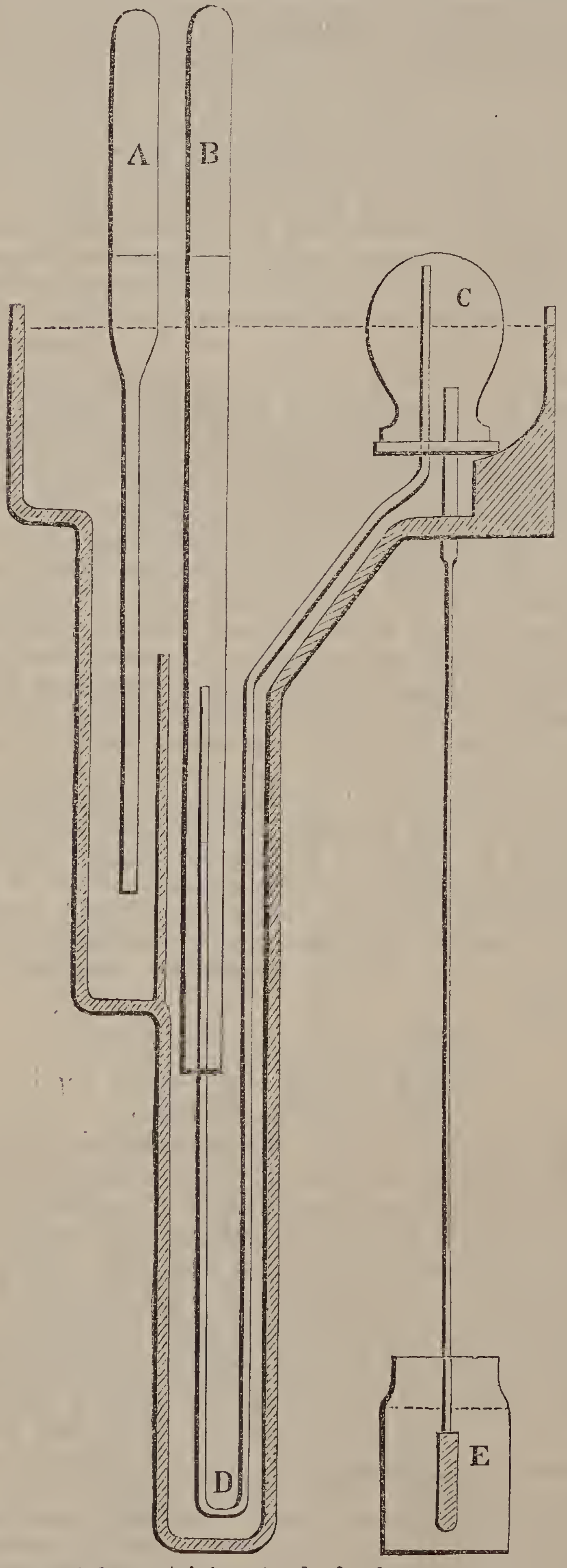
[*] Each unit of the scale adopted was about equal to $\frac{1}{1800}$th of the distance between A and H in the solar spectrum. The measures on different occasions of the same line rarely differed by one of these units, and were often identical.

straight tubes depending, so as to allow of the eudiometer, &c., being wholly immersed in the liquid metal, and at the same time the figure of the trough reduced to a minimum the quantity of mercury required to fill it. This trough was supported on a triangular wooden stand, with table-top fixed at a convenient height, upon which substantial iron rods were mounted for holding the several pieces of glass apparatus, and the telescope employed in reading the graduated divisions on the eudiometer; upon the opposite side of this table were also placed the gas lamp and paper screen for showing a bright diffused light. The glass apparatus consisted of (A) pressure tube containing the standard volume of air; (B) Bunsen's eudiometer; (C) a supplementary glass bulb, having a large lower orifice closed firmly by pressure upon a pad of india-rubber and metal. This is termed the "laboratory vessel;" it is here that all absorptions are conducted. D is a syphon tube of small internal diameter, and serves in transferring the gas from the eudiometer to the laboratory vessel, and *vice versa*. The length of the shorter limb must, of course, be equal to, or slightly exceed, the height of the eudiometer, and its longer limb be conducted inside and to the very top of the laboratory vessel, the convexity of which favours the escape of every trace of gas, particularly if the head of the syphon tube be itself rounded to correspond. E is a glass tube of greater length than thirty inches, the lower extremity of which may be closed by pressure exerted by means of a clip upon a short piece of caoutchouc tubing; its upper end is firmly secured through the caoutchouc pad with the laboratory vessel; this tube having been filled with mercury, and standing in a small cistern of the same metal, it is manifest that by opening the spring clip at the lower caoutchouc joint, a Torricellian vacuum will be created, and the laboratory vessel be emptied of mercury, so that afterwards the gas in the eudiometer will at once pass over upon opening the intermediate syphon communication. The inventors prefer to use the chemical reagents either in a solid or plastic condition. For instance, in absorbing carbonic acid, they would paint the interior of the laboratory vessel with fused hydrate of potassa, using for such application an iron-wire brush. The rate of absorption was slower than when the alkali was employed in the form of a solution; but there was no difficulty in absorbing from 18 to 20 per cent. of carbonic acid from a gaseous mixture containing this proportion in the space of about five minutes. Pyrogallic acid and potassa, with a minimum of water, was employed for absorbing oxygen; and for the removal of hydrocarbons the coke bullets as usual. For the perfect exclusion of air from the laboratory vessel, it was recommended to damp the edges of the caoutchouc pad and to let fall a few drops of water around the outside junction of the glass and mercury. A convenient mode of refilling this vessel with mercury when the absorption was completely effected consisted in admitting from a reservoir at higher level the requisite quantity of mercury, after having closed by its clamp the lower orifice of the 30-inch tube; and in using a length of vulcanised rubber tubing for this purpose, it was desirable to keep it slightly moistened, both externally and internally. It may be sometimes necessary to alter the level of the mercury in the trough. This is best accomplished by sinking or raising a thick glass cylindrical tube, supported constantly at one end of the iron trough. The eudiometer and standard pressure tubes are each supported by long upright rods of steel, which pass with friction through ferrules or collars attached to the substantial mountings of the apparatus. Adjustments in height are easily controlled by loosening the set screws and turning a spindle, around which is wound a cord of catgut. The height of the mercurial level is read off against a horizontal black bar, which is carried by the steel upright of the pressure tube; and when the standard line is in exact adjustment, the telescope is turned aside, and the calibrations of the eudiometer thus brought into view. If, therefore, the levels are exactly coincident, the volume of gas in the eudiometer must correspond in pressure with the air enclosed within the standard tube; and, further, if the two tubes are surrounded with an outer glass cylinder filled with water, the temperatures must also be identical. The construction of the telescope is very simple; it has only a single lens and crossed wires, but no eye-piece; a very small aperture in front keeps the eye in the proper line of vision, and on the top is a spirit-level to show when it is fixed horizontally. A convenient volume of gas to operate upon was 200 millimeters, and in estimating the proportion of oxygen in air the authors had arrived at the

Williamson and Russell's Apparatus for Gas Analysis.



A. Pressure-tube containing standard volume of air.
B. Bunsen's eudiometer.
C. Laboratory vessel in which absorptions are conducted.
D. Syphon-tube for transferring gas from B to C, and *vice versa*.
E. Column of mercury and cistern for producing vacuum in C.

following numbers in a series of experiments upon two samples, viz. :—

Oxygen in 100 *parts of Air.*

I.—21·003	20·997	20·991.
II.—20·976	20·966	20·962.

Carbonic Acid in a Mixed Gas.

I.—18·65 per cent.
II.—18·67 „

	Taken.	Found.
Carbonic acid . . .	12·34	12·40
Oxygen	15·51	15·52
Nitrogen	72·15	72·08

Another experiment (not reduced to percentages) :—

	Taken.	Found.
Carbonic acid . . .	44·14	44·14
Oxygen	31·39	31·41
Nitrogen	182·45	182·43

Dr. Russell's description was supplemented by a few remarks on the part of the President, who narrated some of his difficulties in maintaining a vacuum over mercury. When all the parts of the apparatus were dry the air entered at a great speed, and even with the use of water to cover the joints he sometimes had observed a bubble of air as big as a pea collect in the space of ten minutes ; in such cases he attributed its appearance to the solution of the air in water and subsequent liberation in a vacuum. By applying a strong pressure in forcing down the laboratory vessel upon its caoutchouc pad this annoyance could be overcome.

A vote of thanks to the President and Dr. Russell for their interesting communication was carried with acclamation.

Professor Wanklyn then gave a short account of experiments, by Dr. Erlenmeyer and himself, "*On Isomeric Hydrocarbons.*" Referring to the law expressive of the composition of the hydrocarbon series, it was assumed that their constitution was invariably $C_nH_n + {}_2$. Products were, however, obtained which differed widely in chemical character, although having an identical composition ; thus, Schorlemmer had described a hydrocarbon having the formula $\cancel{C}_6H_{14}$, and Cahours and Pelouse obtained another substance from mineral oil, but these had very different properties from the β hydride of hexyl prepared by the authors. The latter was remarkable for its power of resisting the action of chlorine and oxidising agents, and when eventually compounds were formed, it was found that the original type was destroyed by the splitting up of the substance into representatives of distinct series.

The Chairman announced that M. Aupin, pupil of Professor Malaguti, had succeeded in detecting silver in the saline residue obtained on evaporating the water of the Dead Sea. One milligramme of silver was contained in two kilogrammes of the saline matter. (One part of the precious metal in two million parts of salt, or seven grains to the ton !)

The President then addressed the Society on the subject of "*The Classification of the Elements according to their Atomic Weights.*" At the outset the author stated that he had no experiments to bring forward, but merely suggestions to offer in regard to the work of others. It appeared that the elements were capable of division into two groups, the first of which only furnished an *even* number of atoms to any molecule ; the remainder, or second group, including those which furnished either an *odd* or *even* number of atoms to any molecule. In the first group were enumerated the following elements :—Hydrogen, fluorine, chlorine, bromine, iodine, [lithium, sodium, potassium, cesium, rubidium, thallium], silver, [nitrogen, phosphorus, arsenic, antimony, bismuth], boron, gold. Adopting the suggestion of Gerhardt, it had been determined to double the atomic weights of oxygen, carbon, sulphur, and selenium, and the remaining elements must assume a corresponding equivalentic value. The President considered it important that chemists should at once agree as to what were the right atomic weights, and adopt without delay a common language ; a full and early discussion of the whole subject was, therefore, paramount. The author stated the grounds for his removing fluorine from the oxygen group, and placing it beside chlorine ; this was, however, a troublesome element in many respects, for it did form acid-salts, which was never the case with chlorine ; thus the existence of the fluoride of potassium and hydrogen might be adduced as an argument in favour of placing fluorine at the head of the oxygen family. The history and present state of the hypothetical views brought forward in support of the new atomic theory were treated of at great length by the lecturer, as will be seen by the abstract at page 277, communicated by the author.

In adjourning the meeting until June 2, the Chairman announced that Professor Stokes would then address the Society, taking for his subject "*The Detection and Discrimination of Organic Substances by means of their Optical Properties.*" On June 16 an ordinary meeting would be held ; and on June 30 Mr. Way's lecture "*On the Philosophy of British Agriculture*" would be delivered.

Thursday, June 2, 1864.

Professor A W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the preceding meeting having been read and confirmed and the several donations to the Society's library announced, and acknowledged by a vote of thanks, the members proceeded to ballot for the election of Mr. Charles Tomlinson, Lecturer on Experimental Science, King's College, who was duly received as a fellow of the Society. Mr. M. Prentice was then formally admitted by the President, after having attached his signature to the book of obligations.

The President at once invited Professor G. G. Stokes, Sec. R. S., to favour the meeting with the discourse "*On the Detection and Discrimination of Organic Bodies by means of their Optical Properties,*" which he had kindly promised to deliver.

The Lecturer said he felt some little hesitation in appearing before such an audience as the present, chiefly from the circumstance that he had no new chemical facts to offer ; he did not profess, indeed, to have more than a general acquaintance with the latest results of chemical research ; but inasmuch as no one branch of science can be said to stand alone, he believed it desirable that chemists should be induced to avail themselves of the valuable auxiliary aid which was to be gained by a more extended application of some of the principles of optics. The researches of Professors Bunsen and Kirchhoff, Talbot, Wheatstone, Miller, and others, had already paved the way for future experimentalists, but he considered that much remained to be done before it could be said that the optical properties of the elements and their chemical compounds received as much attention, or were as well known, as the remainder of their physical characters. He regretted also that Gmelin's Handbook, and other standard works on chemistry, contained erroneous descriptions in regard to these optical properties ; thus, it was sometimes stated that a substance appeared of a certain colour by transmitted light, and of another specific colour by *reflected* light, when, in the latter case, reflection had little or nothing to do with the phenomenon. The properties most available for the chemist were colour-production by absorption, fluorescence, and reflection, and the phenomena of circular polarisation in a limited number of instances ; but the measure of the refractive and dispersive powers was of no value in the examination of mixed solutions. The lecturer proceeded to define the principle of absorption, taking a blue solution of copper as an illustration, and then showed a very simple arrangement of apparatus for the purpose of observing these effects. It consisted of a small glass prism, having a refracting angle of 60 degrees, mounted vertically at one end of a long wooden tube, the other end of which was closed with exception of a narrow slit regulated by a screw; and against the outside of this aperture, and in front of the lamp a test-tube, or wedge-shaped vessel, containing the solution to be examined, could be supported by means of elastic bands. Even this arrangement might be simplified by holding in one hand the prism, and in the other a separate black board carrying the test-tube and narrow aperture for the admission of light. It was always desirable to make examination of the substance in different degrees of dilution, and especially to guard against the employment of too highly concentrated solutions. Dr. Gladstone preferred the use of a wedge-shaped vessel for holding the liquid, because it readily permitted of viewing different thicknesses; but the lecturer thought the test-tube method more easy of adoption in the laboratory. When a very dilute solution of permanganate of potash was viewed through the prism, it was found to absorb many of the rays which corresponded with the middle of the solar spectrum, and when properly observed there would appear five dark bands of absorption at regular intervals between the fixed lines D and F of Frauenhöfer. By boiling the black oxide of manganese with sulphuric acid, a pink solution was obtained, the red hue of which was formerly supposed to be due to the presence of a small quantity of permanganic acid; but the optical examination showed that this could not be the case, for no traces of the dark bands were visible in the spectrum of this solution. The chromates were distinguished by the complete manner in which they cut off the blue and violent rays. Among the vegetable colouring matters, purpurin, from madder, had distinctive properties. The red solution obtained by boiling madder with alum gave three bands between the lines D and F, that nearest to F being fainter than the others. So delicate was this optical test that the author many years ago detected this constituent in dyed calico, a single grain weight of which was boiled with the aqueous infusion of 100 grains of black tea. Madder itself contained several colouring principles, but the purpurin could easily be isolated by shaking the acidulated extract with ether, in which it was pretty soluble. The position of these dark bands in the spectrum was subject to a shifting through the space of a band-interval; this was effected by the addition of an alkali, as well as by other chemical reagents, the whole group suffering a diminution in refrangibility, or progression nearer towards D. If to the liquid a blue cupro-tartrate be added, one band alone was left visible. The solution of tartrate of alumina had so great an affinity for purpurin that it would withdraw the whole of this colouring matter from its etherial solution, forming a compound which was powerfully fluorescent. Dr. Stenhouse had supplied the author with a mixed colouring matter in which all three of the madder principles were contained—viz., alizarin, purpurin, and rubiacin, and in a piece of the dry material no larger than a pin's head all three substances were distinctly recognised. The double carbonate of uranium and soda showed four bands in the region of the fixed line G. It would be observed that the optical method of examination was only applicable to clear solutions, and in this respect contrasted strangely with the processes of precipitation generally resorted to by the chemist.

(To be continued.)

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 15, 1864.

"*On the Chemical History and Application of Gun-cotton,*" *by Professor* Abel, *F.R.S., Chemist to the War Department.*

(*Continued from page* 270.)

A rapid current of air will also effect the transformation of the combustion of gun-cotton from the ordinary to the slow form if the yarn be enclosed in a moderately wide glass tube, with one end protruding from the tube so that it may be inflamed in the ordinary manner, but, unless the current be very rapid, an explosive mixture of air and the inflammable gases generated from the gun-cotton may be produced in the tube, and become ignited, in which case the gun-cotton will flash into flame instantaneously, and the tube will be shattered by the explosion. If, however, a long piece of thin gun-cotton yarn be passed through a small, narrow, glass tube, one or two inches long, into which it fits so loosely that it may be drawn through very easily, the change in the form of combustion is effected with certainty and without the aid of a current of air. When the gun-cotton thus arranged and placed upon a flat surface is inflamed at one extremity, it burns as usual until it reaches the one opening of the tube; the slow form of combustion then takes place within the tube, and the gun-cotton will continue to burn in the slow manner, emitting only the small tongue of flame after the combustion has reached the portion of yarn on the other side of the tube, which will be entirely burned in this peculiar manner. In fact, to change the ordinary into the slow form of combustion of the gun-cotton yarn *in open air*, it is only necessary to pass a piece of the material through a perforation in a diaphragm of wood, cardboard, or paper, and to allow it to rest upon a flat surface on both sides of the diaphragm. The gun-cotton will burn as usual upon one side of the screen, until its combustion reaches the perforation, when the large bright flame will vanish and the gun-cotton upon the other side of the screen will burn in the slow manner to the end.

The two last experiments show that, if the combustible mixture of gases evolved by the action of heat upon gun-cotton when it is inflamed in open air are prevented, even for the briefest space of time, from completely enveloping the burning extremity of the yarn or twist; or, in other words, if they are forced for an instant to escape only in a direct line with the burning surface of gun-cotton from which they are emitted, those particles of the latter which are in immediate proximity to the burning portion cannot be raised to the temperature necessary for their rapid and more complete combustion, and hence the gases themselves are, in turn, not supplied with sufficient heat for their ignition. Now, as the gases which escape unburned convey away a very large portion of the heat developed by the metamorphosis of the gun-cotton, it is impossible for the latter to continue to burn otherwise than in the slow and imperfect manner. If, however, a flame or highly heated body be held in the path of the gases as they escape, they will at once be ignited, and the yarn will burst into the ordinary form of combustion. The correctness of this explanation may readily be demonstrated by two or three simple experiments. Thus, if a piece of loose or open gun-cotton-yarn is employed in place of the compact material which furnishes the results just described, it is very difficult, or even impossible, to cause the rapid combustion to pass over into the slow form, because the escaping gases cannot be diverted all into one direction, and cannot, therefore, be prevented from transmitting the heat necessary for perfect combustion from particle to particle of the material. Again, if a piece of the compactly-twisted gun-cotton yarn, placed upon a flat surface, is inflamed in the usual manner, and a jet of air is then directed in a line with the gun-cotton so as to meet the flame, the latter will appear to be blown out, though the cotton still burns; in fact, the burning gases are prevented for an instant from completely enveloping the extremity of the gun-cotton, and hence the combustion at once passes from the quick to the slow form. Conversely, if, when the yarn has been made to burn in this slow manner, a very gentle current of air be directed against the burning portion so as to force back upon the latter the gases which are escaping, thus impeding the rapid abstraction of heat, it will very speedily burst into the ordinary form of combustion, because, under these circumstances, the gases are almost immediately raised to the temperature necessary for their combustion. In the same way, if a piece of the yarn, placed upon a board, be made to burn in the slow manner, and one end of the board be gradually raised so that the burning extremity of the gun-cotton is the lowest, the latter will burst into flame as soon as the board has been raised to a position nearly vertical, so that the escaping gases flow back upon the burning surface.

The slow or imperfect form of combustion may be at once induced in the compact gun-cotton-yarn, in open air, by applying to any part of the gun-cotton a source of heat not sufficiently great to inflame the gases generated. A wire or metal rod, heated to any temperature between 135° C. to just below visible redness, or the spark of a thin piece of smouldering string, will invariably produce the result described. Of course, this effect, like most of the phenomena described, is to a considerable extent dependent upon the mechanical condition of the gun-cotton, upon the relation between the *quantity* as well as the *degree* of heat applied, and the amount of surface of the gun-cotton, and upon other conditions. While a small spark, or a thin platinum wire heated to full redness, only induces slow combustion in the compact gun-cotton yarn, a thick rod of iron heated only to dull redness will invariably inflame it in the ordinary manner. A piece of open yarn cannot be ignited so as to burn in the slow manner; on the other hand, the more compactly the gun-cotton is twisted, the more superficial is the slow form of combustion induced in it; indeed, the gun-cotton may be rendered so compact that it will simply smoulder in open air, if ignited as described, leaving a considerable carbonaceous residue; and the heat resulting from this most imperfect combustion will sometimes be abstracted, by the escaping gases, more rapidly than it is developed, so that the gun-cotton will then actually cease to burn, even in open air, after a short time.

The remarkable facility with which the effect of heat upon gun-cotton may be modified, so as even to produce results totally opposite in their characters, as exemplified by some of the experiments which have been described, renders it easily conceivable that this material may be made to produce the most varied mechanical effects, when applied to practical purposes; that it may, indeed, be so applied as, on the one hand, to develope a force, very gradual in its action, which may be directed and controlled at least as readily as that obtained by the explosion of gunpowder; while, on the other hand, it may be made to exert a violence of action and a destructive effect far surpassing those of which gunpowder is susceptible. The results arrived at in Austria, which show that gun-cotton can be made to produce effects from three to eight times greater than those of gunpowder, cease to be surprising after a study of the chemical and physical characteristics of this interesting explosive agent.

The products obtained by the explosion of gun-cotton and its decomposition under various conditions have as yet been very imperfectly studied, but there is little doubt that they vary in their nature almost as greatly as the phenomena which attend the exposure of the material to heat under different circumstances. It is well known that when gun-cotton is inflamed in the open air there is produced—in addition to water, carbonic oxide, carbonic acid, and nitrogen—a considerable proportion of binoxide of nitrogen, so that the gaseous mixture assumes a red-brown tinge, and becomes very acid, when it mixes with air. The products of the varieties of imperfect combustion which gun-cotton has been described as susceptible of undergoing are undoubtedly much more complex in their character than those just referred to. They include at times a proportion of some substances not yet examined, which make their appearance as a white vapour or smoke. Cyanogen can readily be detected in all the products of imperfect combustion. The proportion of binoxide of nitrogen is generally so large that the gaseous product becomes very highly coloured when mixed with air. Peroxide of nitrogen has also been observed in some instances. Lastly, there is little doubt that the products occasionally include a proportion of oxidising gases.

The products which have just been alluded to are the results of the decomposition of gun-cotton either at ordinary or diminished atmospheric pressures. When the explosion of the material is effected in a confined space, in such a manner that the main decomposition takes place under pressure, the metamorphosis which the material undergoes is of more simple and complete character.

It has been found by Karolyi that when gun-cotton is exploded by voltaic agency, in a shell which is burst by the explosion, and which is enclosed within an exhausted chamber so that the products of decomposition are collected without danger, the results obtained, under these conditions, are comparatively simple; the analysis of the contents of the chamber after the explosion showed that they consisted of—Carbonic acid, 20·82 per cent.; carbonic oxide, 28·95; nitrogen, 12·67; hydrogen, 3·16; marsh gas, 7·24; water, 25·34; and carbon, 1·82. The decomposition of gun-cotton under these conditions, which are similar to those of its explosion when employed as a destructive agent, appears, therefore, not to be attended by the production of any oxide of nitrogen. The lecturer found, in some preliminary experiments made under the same conditions as those of Karolyi, that only a minute proportion of binoxide of nitrogen was produced. These results, when compared with those obtained by the ignition of gun-cotton in open air and rarefied atmospheres, show that, just as the decomposition of this material is of a more complicated and intermediate character, in proportion as its combustion is rendered imperfect by diminution of pressure or other circumstances, so, conversely, the change which it undergoes will be the more simple, and its conversion into gaseous products the more complete, the greater the pressure, beyond normal limits, under which it is exploded—that is to say, the greater the resistance offered to the generated gases upon the first ignition of a charge of gun-cotton (and, consequently, the higher the temperature at which the decomposition of the confined gun-cotton is effected). It is, therefore, readily intelligible that the notions hitherto generally entertained with regard to the very noxious character of the products of explosion of gunpowder and their powerfully corrosive action upon metals, based as these notions have been upon the effects observed on exploding gun-cotton in open air, have been proved to be erroneous by the results of the actual application of gun-cotton to artillery and other purposes. The foregoing considerations contribute, moreover, to the ready explanation of the fact established by the experiments in Austria, that the destructive effect of gun-cotton is greatly increased, within certain limits, by increasing the resistance which the products of explosion have to overcome before they can escape into the air.

The conditions (of temperature, pressure, &c.) which influence the nature of the decomposition of gun-cotton, exert, unquestionably, a similar influence upon the nature of the explosion of gunpowder, and upon the mechanical effects which its products are capable of exerting. Observations made by the lecturer in experiments upon the ignition of gunpowder in rarefied atmospheres point to the existence of products of comparatively complicated character among those found by the gradual decomposition of that material, under the conditions described. The earlier investigators (Guy Lussac, Chevreul, &c.) of the products of explosion of gunpowder represent these as being of a very simple character, and in harmony with the theory that gunpowder is converted essentially by its explosion into carbonic acid (or a mixture of that gas and carbonic oxide), nitrogen, and sulphide of potassium. But more recent experimenters, Bunsen and Schischkoff, who have made a very elaborate examination of the products which they obtained by the explosion of gunpowder, represent the change to be one of a very complicated character; fix the percentage of solid substances found at a much higher figure than that hitherto accepted; and show that the sulphide of potassium, which has hitherto been considered as the principal of these products, was only produced in very small proportion in their experiments. The conditions under which these chemists exploded the gunpowder did not, however, correspond in their character at all to those under which gunpowder is exploded in actual practice, and would, therefore, be very likely to furnish results greatly at variance with those produced when a charge of powder is fired in a gun, a shell, or a mine. That sulphide of potassium is abundantly produced upon the discharge of a firearm appears beyond doubt; it may be readily detected in the solid matter which remains in the barrel near the breech; it may be found deposited in considerable quantity near the muzzle of the arm; and there appears strong reason for believing that the flash of flame observed at the mouth of a firearm, upon its discharge, is due in part to the ignition, as it comes into contact with the air, of sulphide of potassium, which has been vaporised by the heat of the explosion, and is thus mixed with the escaping gases.

In comparing the effects of gun-cotton, as an explosive agent, with those of gunpowder, and in basing theories with regard to the difference in the mechanical effects exerted by the two, upon the analytical results of the products of their explosion which have been obtained up to the present time, it is necessary to proceed with great caution; for exceptional results cannot form any sound basis for correct theories or tenable arguments. It can only lead to incorrect conclusions, which may considerably retard the thorough investigation of a most important subject, if the facts be ignored or lost sight of—that, firstly, the conditions which practically influence the nature of the products of the explosion of gun-cotton have a similar influence upon the changes which gunpowder may be made to undergo; and that, secondly, the effect of heat upon the water produced by the decomposition of gun-cotton, which forms so important an element in the action of this explosive, has most probably its parallel, to no unimportant extent, in the vaporising effect of heat upon the solids (especially upon sulphide of potassium) produced in the explosion of gunpowder. These are matters which demand their full share of consideration and investigation before it can be admitted that a sufficient explanation of the remarkable differences between the effects of gunpowder and gun-cotton exists in the assumption that certain products of decomposition of the former must be regarded entirely as waste matter in the material, simply because they are solid *at ordinary temperatures.* The fact that gun-cotton is *entirely* converted into gases and vapour *at the moment of explosion* constitutes unquestionably one of the great advantages which that substance possesses over gunpowder; but it is premature, at present, to assume, in comparing the action of the two substances, that only 32 per cent. (or even 60 per cent.) of gunpowder exist as gas or vapour *at the moment of its explosion.*

It is to be expected that the investigations which are now being actively pursued upon the true chemical effects produced in the explosion both of gun-cotton and gunpowder, under conditions similar to those which attend their employment in practice, will aid materially in furnishing the correct data so essential for a thorough and impartial comparison of the nature and merits of these two explosive agents.

ACADEMY OF SCIENCES.

May 30.

MM. Bussy and Buignet communicated a note in reply to the strictures of M. Blondlot on their "*Method of Purifying Sulphuric from Arsenious Acid*" (see page 225). They say that experiments have proved to them that ammonia has no reducing action on arsenic acid, and, consequently, their process is free from the objection brought against it by M. Blondlot.

MM. Daubrée and Cloez give a very interesting account of some "*Meteorites which fell in the Neighbourhood of Orgueil*" on the 14th of last month. The most curious fact mentioned by M. Cloez is that the stone he examined contained a notable quantity of chloride of ammonium, with chlorides of potassium and sodium and sulphates of magnesia and lime. Five per cent. of the stone, in fact, was soluble in water.

A note by M. Gal, "*On some Derivatives of the Chloride and Bromide of Acetyle,*" describes the monochlorinated and monobromated chlorides of acetyle, and the monochlorinated bromide of acetyle.

A paper by M. Blondeau gave an account of the "*Action of Sulphuretted Hydrogen and Ammonia on Gun-cotton.*" The author considers the gun-cotton $C_{12}H_{10}O_{10}(NO_5)_3$ as a definite compound representing the ether of a triatomic alcohol, which can only be cane sugar $C_{12}H_{11}O_{11}$. He is confirmed in this notion by the behaviour of ammonia in regard to it. Gun-cotton fixes ammonia and forms a triamide, which, according to analysis, may be represented by the formula $C_{12}H_{10}O_{10}(NO_4)_3(NH_2)_3$, to which the author gives the name *cellulo-nitric triamide.* When treated with potash three equivalents of hydrogen in this compound are replaced by three of potassium, and when this compound is treated with a soluble salt of lead the other three equivalents of hydrogen are replaced by three of lead, and we have a *plumbo-potassic cellulo-nitric triamide.* The cellulo-nitric triamide also absorbs sulphuretted hydrogen and forms a *sulphide of cellulo-nitrous triamide*—

$$C_{12}H_{10}O_{10}(NO_3)_3(NH_2)_3S_3.$$

A paper, by M. Maumené, entitled "*A General Theory of the Exercise of Affinity,*" was presented. An abridgment would hardly convey an adequate idea of M. Maumené's theory, so we shall leave it for the present, with the remark that the principle the author seeks to establish is the following:—That the masses which really act in producing chemical action are determined by, and are proportional to, their densities.

M. Hugo Schiff made a communication "*On Some Derivatives of Ethylidene.*" The author describes two new series of bases and a host of derivatives, and the length to which his experiments were extended may be judged from the fact that he mentions having obtained the chloride of dimercurodiethylidenediphenammonium.

NOTICES OF BOOKS.

Manual of the Medicinal Preparations of Iron, including their Preparation, Chemistry, Physiological Action, and Therapeutical Use. With an Appendix containing the Iron Preparations of the British Pharmacopœia. By Harry Napier Draper, F.C.S. Dublin: Fannin and Co. London: Hardwicke. 1864.

This is a kind of book which we are happy to welcome and recommend. Numerically, the iron preparations form the most important class of remedies with which the pharmaceutist and medical practitioner have to deal. To the pharmaceutist they offer some difficulties, for their successful preparation often requires a considerable amount of skill and experience, and sometimes chemical knowledge. Very few can be safely prepared by merely putting the ingredients together, and following as nearly as possible written directions.

Take as examples the scaled preparations which have now become so numerous and popular. How many have succeeded in their first attempts at making any one of these medicines? A good deal, in fact, might be written on these preparations alone; and the only deficiency we notice in Mr. Draper's book is the want of practical information on this part of his subject. He leaves, in fact, the Pharmacopœia directions for Ferri et ammoniæ citras without the remark that the solution must first be evaporated to a proper consistence for scaling, or no scales will be obtained. We should have been glad to have had the author's experience with the Pharmacopœia process for Ferri et quinæ citras.

After these remarks we may express hearty approbation of both the matter and manner of Mr. Draper's book. It is an excellent manual, which we confidently recommend to pharmaceutists.

Annales de Chimie et de Physique. April, 1864.

The chemical papers in this number of the Annales have for the most part already appeared either at length or in an abridged form in the Chemical News, and one by M. Berthelot on the action of sulphurous acid on sulphur will appear shortly, as well as the conclusions at which M. Scheurer-Kestner has arrived in the course of his theoretical researches on the manufacture of soda by Leblanc's process. The memoir of M. Deschamp "On the Dried Capsules of the Papaver Somniferum" gives the particulars of his process for extracting *papaverosine*, the new body we mentioned a week or two ago. The author has not yet finished his study of this substance, and as yet gives no formula for it.

We see with pleasure the valuable paper "On the Estimation of Phosphoric Acid by Magnesian Salts," by Mr. R. Warington, jun., reproduced here, as well as other interesting matter from English journals. We notice, too, that in this, the first number of a new volume, the editors have adopted a plan similar to our own of giving the titles and sometimes abridgments of all the papers in foreign scientific journals. From these abridgments we shall often have occasion to borrow.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

949. John Milnes, Gloucester, "Improvements in fuel."—Petition recorded April 15, 1864.

1151. Andrew Barclay, Kilmarnock, Ayrshire, N.B., "Improvements in certain apparatus for injecting and ejecting fluids."—Petition recorded May 6, 1864.

1199. Otto Sachs, Aldermanbury, London, "Improvements in the manufacture of aniline dye colours."—A communication from Richard Froehling, Gesundbrunnen, Berlin, Prussia.

1200. John Phillips, Hatton, near Leeds, Yorkshire, "Improvements in the purification of coal gas, and in the application of the products resulting from such purification."

1205. Thomas Nesham Kirkham, West Brompton, and Vernon Francis Ensom, Highgate, Middlesex, "Improvements in cleaning, bleaching, and dyeing woven fabrics and piece goods."—Petitions recorded May 12, 1864.

1228. Alfred Fryer, Manchester, Lancashire, "Improvements in treating animal charcoal in the process of revivification, and in apparatus employed therein."—Petition recorded May 14, 1864.

1232. Joshua Womersley, Norwich, "Improvements in the manufacture of paper from certain fibrous substances."

1234. William Reid, Adelaide Road, Haverstock Hill, Middlesex, "Improvements in apparatus used for testing the insulation of electric telegraph wires or conductors."—Petitions recorded May 16, 1864.

1236. William Wilson, Manchester, Lancashire, "Improvements in, and apparatus for, generating gas from hydro-carbon or other volatile oils for illuminating and other purposes."—Petition recorded May 17, 1864.

1252. Richard Smith, Glasgow, N.B., "Improvements in obtaining colouring matters."

1254. John Bilby Merrikin, Bath, Somersetshire, "Improvements in bottles or vessels for containing poisons."

1258. James Webster, Birmingham, Warwickshire, "Improvements in the manufacture of zinc."—Petitions recorded May 18, 1864.

1262. Thomas Dunlevie, Dublin, Ireland, and John Jones, Liverpool, Lancashire, "Improvements in metallic alloys."

1270. Joseph Freeman, Edward Grace Freeman, and Charles Henry Freeman, Bridge-road, Battersea, Surrey, "Improvements in treating oil and spirit varnishes, and also drying oils and turpentine in order to bleach and otherwise improve the same."—Petitions recorded May 19, 1864.

Notices to Proceed.

164. James Turner Hall, Edgehill Station, Liverpool, "An improved combined lantern and lamp for burning petroleum and other like hydro-carbon fluids."—Petition recorded January 21, 1864.

194. Thomas Bright, Carmarthen, "Improvements in kilns and apparatus for drying malt, corn, hops, and other vegetable substances."

196. John Platt and William Richardson, Oldham, Lancashire, "Improvements in the preparation of clay for the manufacture of bricks, tiles, slabs, or other articles which may be made of such material."

200. Eugen Lucius, Frankfort-on-the-Maine, Germany, "Improvements in the manufacture and production of colours."—Petitions recorded January 23, 1864.

203. William Ibotson, of Wraysbury, Buckinghamshire, "An improvement in the process of bleaching materials for paper-making."—Petition recorded January 25, 1864.

226. Johann Zacherl, Vienna, "An improved tincture or liquid preparation for destroying insects."—Petition recorded January 27, 1864.

937. Thomas Stevens, Glasgow, and Charles Batty, London, "Improvements in arrangements and apparatus for ventilating, for protecting from heat, and for heating and cooking."—Petition recorded April 14, 1864.

CORRESPONDENCE.

Patent Law.

To the Editor of the Chemical News.

Sir,—It is a fact of every-day occurrence that lawyers convert or pervert facts into anything suitable for their purpose, however widely different they may be intended to the construction put upon them. In the case of "Young *v.* Fernie" many instances occur; take my own examination. I had prepared oils containing paraffine from cannel and other coals, shales, bituminous sand-stone (swine-stone), and petroleum, from the year 1845—five years, at least, before Young's patent in 1850—and had offered them in the market during those years, and had sold a considerable quantity as naphtha and burning oil and also for lubrication, and a portion thereof to Mr. Parkes, specially for preparing paraffine therefrom, as you will observe by his evidence (26th day, p. 9), which is not attempted to be denied; and I had also separated paraffine therefrom myself, and, further, I had obtained similar oils to Mr. Young from the so-called Boghead coal in October, 1849, twelve months before his patent; but because I was so situated that I could not obtain that article upon reasonable terms, owing to my distance therefrom, and I was not prepared to go to the Boghead and the cannel of my own neighbourhood, being an irregular production, obtained only occasionally, I am called an unsuccessful manufacturer, according to the judgment of Vice-Chancellor Sir J. Stuart, and who, to make my failure more apparent and complete, calls to his aid "the order of withdrawal of my samples from the Exhibition of 1851 on account of their quality and offensive smell," whereas they had not been examined, and the cause of their being withdrawn was on account of their being with some samples of bisulphide of carbon, chloride of sulphur, &c., the stopper of the bottle containing the last article having become loose from mishap or inattention by my agent, and this, I think, you will consider a good cause of complaint, knowing the article; but it pleased the Vice-Chancellor to apply the cause of withdrawal to the oils, which was unjust.

In drawing a just comparison between the oils I produced and those of Mr. Young it should not be overlooked that Mr. Young was very far from perfecting his oil even up to 1857, and then the smell was very objectionable to most people, and remains so even to this day; and further, the oils offered for sale by him in the early years of his patent were not coal oils, but mixed oils, and consequently the smell would not be so strong as pure mineral or coal oil. Upon reference to Mr. Poynter's evidence (twenty-sixth day, page 20) you will observe that, from 1853 to 1856 Mr. Young only obtained 6d. per gallon for his burning oil, and that "*it had not a pleasant smell.*" During this time I was obtaining for what I sold prices ranging from 1s. to 7s. per gallon, showing a state of purity superior to Mr. Young. The latter I sold to Mr. Bailey, of Wolverhampton, in 1854, for the preservation of potassium and sodium. Unfortunately I could not obtain materials to work upon regularly, but of late years I have sold an oil for burning superior to Mr. Young's for burning qualities, colour, and smell. This was not referred to in my evidence, being mostly confined up to the years 1851-52, when I made a series of experiments for Mr. Clift, agreeable to his own wishes, and which had nothing whatever to do with my previous workings of 1845 to 1851.

Mr. Grove (thirty-third day, page 17) thinks if my claim was just I should have written to the *Gas Journal* or some other public paper on the subject. Allow me to say I am not very partial to bringing my claims or name before the public. I have suffered severely through patents, and have no desire to possess them, being well aware that uneasy lies the head that owns one; and I have anything but a predilection in favour of law or lawyers.

I have written this simply to correct some of the statements of the Vice-Chancellor. I am, &c.,

Jesse Fisher.

Ironbridge, June 4, 1864.

Safety Matches.

To the Editor of the Chemical News.

Sir,—About two years ago you favoured your readers with a notice of the then newly introduced Patent Safety Matches, and partly in consequence of your announcement I was induced to forbid the purchase by my household of the old phosphorus matches. From that time I have continued to use the matches requiring a special friction-surface for their ignition, and have always been supplied with those sold under the above name, or with the "Imperial Safety Matches." I have, however, lately remarked an objectionable peculiarity to which the latter seem especially liable. It is, that at the moment of ignition a dense white cloud of volatilised metallic compounds escapes into the atmosphere, which makes itself at once apparent by the nauseous flavour and odour diffused in the apartment. The lighting of a single match is enough to pollute the atmosphere of a small room, and for bedchamber lights I find it impossible to continue their use.

I have made a few analytical experiments for the purpose of arriving at the primary cause of the objectionable property now complained of, and find, in the first place, that the match composition is applied so liberally to the head of the wooden splint, that from sixteen of the latter matches I removed not less than ten grains of the combustible material; and on further examining this, I discovered that it contained a very large proportion of the grey sulphuret of antimony, besides a quantity of brown oxide or some other compound of lead. In the presence of the oxidising agents commonly employed in the making of matches, it is well known that these metallic substances on ignition give off poisonous vapours; and, when burnt in large quantity, as in the Bengal signal lights, it is always necessary to inflame them in the open air, so as to avoid inhaling the fumes of lead and antimony.

Many of the cheap cigar-lights also contain large quantities of these deleterious ingredients; and believing that the fault requires only to be pointed out in order that it may be practically overcome, I am, &c., S. J.

June 6.

MISCELLANEOUS.

Conversazioni at Apothecaries' Hall.—On Tuesday, May 31, the Master and Wardens of the Society of Apothecaries gave a brilliant microscopical *conversazione* at their Hall. Most of the noted makers of microscopes sent instruments, and a large number were contributed by private and professional gentlemen. The noble hall was hung with diagrams illustrative of comparative anatomy, and in the library a number of botanical diagrams and dried plants were suspended. In the board-room, darkened for the occasion, Mr. Atkinson showed the rotation of the electric spark around a magnet in a vacuum. This is a beautiful experimental illustration of Faraday's well-known discovery, devised by Rhumkorff. In the same room the Messrs. Wheeler showed some interesting experiments in electrolysis, and illustrated the allotropic conditions of several elements. One of the experiments was the electrolysation of water by means of carbon poles, in which carbonic acid is obtained at the negative pole in place of oxygen. Of this experiment we shall give a further account. On the Wednesday morning the same gentlemen made a series of brilliant experiments with twenty-four cells of a carbon battery constructed by themselves. With this battery they produced a powerful electric light, and exhibited the arc of the thallium flame on a screen. Iron and zinc were burned with the same battery. Mr. Ladd attended on both occasions with his vacuum tubes. Besides the microscopes, a number of other scientific instruments were displayed. Messrs. Spencer Browning and Co. showed spectroscopes. Messrs. Murray and Heath showed a polarising apparatus and a stereoscope on a new principle. Mr. How exhibited, besides microscopes, an electromotive machine in action, with an ingeniously-contrived regulator; he also showed the fluorescent properties of a solution of sulphate of quinine by means of a vacuum tube in a large glass dish of the fluid. The *conversazioni* were very numerously attended (by gentlemen in the evening and ladies in the morning), and the company seemed to derive great gratification.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

A Frenchman.—Received.

A Reader.—Solution of potash.

A Student.—1. Write to Dr. Redwood, the Secretary. 2. Write to Mr. Trenham Reeks, School of Mines.

J. A. M. and Co.—An answer by post.

Received.—W. S. Gossage.

Book Received.—"Dictionary of Chemistry," Part XVI.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Detection, Distinctive Characteristics, and Estimation of Natural Organic Alkaloids, by M. ALFRED VALSER.

[THE following notice of a recently published thesis will probably supply our readers with a few useful hints on the subject of which it treats.—ED. *C. N.*]

The thesis is divided into three parts. The first gives the means for filling up the hiatus in Stas's process for morphine, and indicates a general reagent for alkaloids. The second part treats of the reactions peculiar to each. The third part concerns the determination of their equivalents.

In the first part of his paper M. Valser clearly shows the insufficiency of Stas's process, an insufficiency already pointed out by MM. Lefort and Reveil relative to the detection of morphine in poisoning cases. Being insoluble in ether, morphine could not be obtained free by that method. The author has endeavoured to substitute for common ether a solvent capable of obviating this inconvenience. This substitute he has found in acetic ether, which dissolves morphine at least as well as alcohol. After devising a method for rectifying commercial ether, he makes use of this solvent in the following way:—

The substances to undergo examination having been treated as far as possible by Stas's method, he adds to the residue already exhausted by ordinary alcohol a certain quantity of potash and acetic ether, which take up any morphine there may be remaining. On evaporating separately the simple etherised liquid and the acetic ether liquid, the morphine left in the residue left by the latter is recovered, all other vegetable bases being included in that which furnished the simple ether. At this point it is necessary to ascertain whether these residues are indeed the alkaloids. Their usual reagents, such as tannin, chloride of gold, iodised water, phosphomolybdic acid, &c., not being exempt from drawbacks, the author prefers the reagent used by M. de Vry in researches on atropine and strychnine; that is to say, double iodide of mercury and potassium. M. Valser finds it possesses the invaluable property of entirely precipitating alkaloids, it being so exquisitely sensitive to their presence as to indicate $\frac{1}{100000}$ of strychnine in a liquid. Moreover, this double iodide precipitates none of the other principles contained in the vegetables, except the albuminoid matters; but the presence of these matters is not encountered, since they are eliminated by the ether in Stas's process.

These facts once admitted, the author makes use of this reagent, whose general utility and sensibility are incontestible, to establish the presence of alkaloids in oils of belladonna, hemlock, &c., which before was only suspected.

The second part is devoted to researches on the distinctive characteristics of alkaloids. Finding the most characteristic reactions on these matters produced by oxidising bodies, the author tried each of them successively at various temperatures; sulphuric acid alone or associated with binoxide of barium or binoxide of lead; hydrochloric acid with binoxide of barium; chloride of gold and caustic potash. With each he elicited distinctive characters.

The third part comprises a study of the estimation of alkaloids and the determination of their equivalents. "Observing with what facility the solution of double iodide of mercury and potassium detected the least trace of alkaloids, the author was induced to examine whether the resulting combination could be exactly defined, and whether he could obtain a precipitate invariable in weight and characteristic of each of them." Such, in effect, is the result he obtained whilst experimenting on a certain number of vegetable bases. The high equivalent of the reagent employed, the great density of the alkaloid precipitates, their insolubility in aqueous liquids, even when acidulated, enabled him easily to determine, not only the composition of these precipitates, but the equivalents of the alkaloids themselves.

This new method leads M. Valser to conclude that we must revert to the old equivalents for quinine and cinchonine, which are but half those since adopted. He also found by the same means that quinidine is isomeric, not polymeric, with quinine.

The author desired to apply his reagent for the estimation of vegetable alkaloid matters, but the presence of albuminous and extractive principles vitiated the results. Further, perceiving that the processes used in these researches, besides being insufficient, occupied too long a time, he successfully modified them by combining the successive action of the proper solvents in presence of lime, which isolates the alkaloids, and of tannin, which assists in decolorising the liquids. This process, too long to be here described, greatly shortens the operation, and isolates purer products.

Such is the summary of M. Valser's paper. He has not feared to attack excessively delicate toxicological and chemical questions. Without diminishing the precision of Stas's process, he has, by extending it, rendered it applicable to the research of morphine. He has generalised a valuable reaction to isolate alkaloids by employing double iodide of mercury and potassium, which precipitate them so effectively. This reagent has demonstrated the presence of some vegetable bases in certain medicinal oils. He has besides discovered some new reactions for distinguishing the principal organic alkalies one from another. Then proceeding methodically, he utilised the valuable iodhydrargyrate of potash for the rigorous determination of the equivalent of alkaloids, rectifying some, changing others, all deduced from numerous correct and unexceptionable analyses, and finally crowned all by planning a general process for the estimation of all matters containing alkaloids.—*Journal de Pharmacie et de Chimie*, xliii., 49, 63.

TECHNICAL CHEMISTRY.

On Aniline Black.

WHETHER aniline black exists or not is a question, notwithstanding the patents which have been taken out for its production.

As to a black colour so long desiderated, that is to say, a colour capable of general application to every kind of fabric, there is no such thing as aniline black,—belief in its existence is but a passing delusion.

We notice this subject in the hope of stimulating inquirers to fresh experiments and researches which may overcome the difficulties now opposing the extended application of this colour, remarkable as much for its beauty as for the curious reactions which produce it.

At present its application is extremely limited, and besides it is subject to so many inconveniences and irregularities that some of the first manufacturers have provisionally ceased to employ it.

In the fabrication of aniline violet by bichromate of potash (Perkin's process) there is obtained, besides a very small quantity of violet colour, a large quantity of a black (resinous?) matter,[*] combined or mixed with sesquioxide of chromium, resulting from the reduction of chromic acid. Attempts have been made to use this black for printing black or grey, fixing it on the stuffs by albumen, but the tints not equalling those of carbon it has been abandoned. It seems that these residues will now be used for regenerating chromic acid.

This idea of applying the residue to printing stuffs was the first step leading to a process for effecting the reaction on the tissue itself, on the fibres which the residue (in this instance the useful matter), would become precipitated, and fixed almost indelibly.

On the other hand, M. Emile Kopp first, I believe, then MM. Gerber Keller and Crace Calvert, some years ago, showed that slightly acid solutions of aniline salts, mixed with a solution of chlorate of potash or soda, gave, by moderating more or less the action of the chloric acid, a great number of tints, from light green to greenish black. These tints are obtainable with equal facility on stuffs impregnated with a mixture of the two solutions, as in the liquid itself.

About eighteen months ago the English house of Lightfoot obtained a patent in England and France, for the application of an aniline black by the process described further on. This patent was purchased by a Swiss house, to be carried out in both countries.

Aniline Black.

Water	6 litres.
White starch	850 grammes.
Chlorate of potash	180 ,,
Dry hydrochlorate of aniline	450 ,,
Sulphate of copper	180 ,,

Stuffs printed with this preparation should be exposed for three days in a hot, moist, oxidating chamber. At first extremely faint, the colour gradually deepens to black, when, after two days' exposure to the air, the fixation of the dye may be hastened by steaming the pieces. We believe, however, the latter process may weaken and even seriously deteriorate the tissue.

An experienced chemist will, at first sight, perceive one great drawback to the process—the large amount of copper entering into its composition. In fact, in roller printing scrapers or plates of steel are used; now these scrapers are rapidly attacked by all the colours into which even a small quantity of salts of copper enter, and in order to produce a distinct impression and to avoid soiling the other colours and the parts of the tissue which should remain white, the printer is obliged to constantly renovate the scrapers with file and stone to restore to them the necessary edge and polish. All this entails great loss of time, and an irregular and defective impression.

This inconvenience has been obviated by preparing the material with a solution of salt of copper instead of adding it to the colour. But the application of aniline black is by this means much limited, as there are very few colours which can be printed on materials thus prepared; and now-a-days processes are required by which four, five, seven, ten colours can be simultaneously employed.

The preparation of stuffs by bichromate of potash has also been tried, but we are not aware that any favourable results have been obtained. We should imagine that a less vivid and less velvety black would be the result, for in general all colours containing sesquioxide of chromium in notable quantity are dull and earthy.

Mulhouse's Process.—Some months since a manufacturing firm at Mulhouse believed they had found a process, which, if not infallible, was much superior to the English process. It was also patented, and the patent sold to the same Swiss house which bought the English patent.

A notable progress is made in this new process, but it is still far from realising the expectations formed on its first announcement.

The process is as follows:—

Thickening.

White starch	27 kilog.
Water	18 litres.
Gum water, 1 kilogr., 200 per litre	30 ,,
Tragacanth gum water, 65 gr. per litre	24 ,,

Digest these.

Preparation No. 1.

Hot thickening	25 litres.
Chlorate of potash	1·350 kilog.
To which is added when cold ferricyanide of ammonium	3·900 ,,

Preparation No. 2.

Hot thickening	26 litres.
Dry powdered hydrochlorate of aniline	3·600 kilog.
Tartaric acid	3·750 ,,

For the colour for printing stuffs take—

No. 1	1 part.
,, 2	2 parts.

The following difficulties and inconveniences attending the application of aniline black must be either conquered or surmounted:—

1. These two colours, whose preparation we have given, are subject to rapid decomposition, the second much more so than the first.

2. The oxidation or the formation of the black takes place irregularly. To produce adequate regularity, it is necessary to study exactly the temperature and humidity of the oxidising rooms, as well as the time the material should remain there.

3. To find a means of terminating the reaction, or formation of black on the stuffs, or removing the still unfixed products before the pieces are finished, for if the colour works (as it is called) after the material is considered ready for sale, unequal tints and, consequently, damaged goods will be the result.

4. To prevent the aniline colour mixing with other colours, and attacking them in roller printing, where several colours ought to touch without injuring each other or mixing, and especially to prevent a slight running which destroys the clearness of outline, and is a more serious fault with black than with any other colour.

5. Finally, what in many cases is a most valuable quality becomes a fault with aniline black—its fixity, its indelibility. No reagent is yet known which will entirely destroy this colour. It resists even two or three entire bleaching operations; hence some chemists are of opinion that it is carbon reduced or isolated from aniline. However, salt of tin (stannous chloride) will partially decolorise and destroy it.

In printing factories pieces of unbleached calico, doubled, are used to preserve the woollen cloths in the printing tables and printing machines. These calicos become impregnated with the whole mass of colours used in printing white stuffs. These doubled cloths are

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[*] This black matter is also obtained by preparing the violet by hypochlorite of lime, in which case it is naturally free from oxide of chromium.

afterwards bleached, and become as white as if they had never been applied to such a purpose. This is unfortunately not the case with aniline black, which, as we have already said, resists bleaching. There are also spots, splashes, marks of scrapers, &c., unavoidable in printing factories; there is no means of getting rid of these, and the manufacturer has damaged pieces. — *Moniteur Scientifique*, vi., 433.

Manufacture of Fatty Acids for Candle and Soap Making, by M. H. MEGE-MOURIES.

MY researches on amylaceous grains, especially wheat, have furnished the means of substituting for brown bread, in Paris, a cheaper and more nourishing kind.

Analogous studies on oleaginous grains have altogether modified the economical conditions of two great manufactures. I will proceed at once to the results.

In oleaginous grains during germination, as in the animal economy during life, neutral fats pass, before undergoing any other modifications, into the state of very mobile globules, presenting a very large surface to the action of reagents.

In this globular state fatty bodies manifest peculiar properties; we will mention those directly connected with the subject of this memoir.

1st. A fatty body in the ordinary state—suet, for instance—quickly becomes rancid by exposure to damp air; in the state of globules, on the contrary, it will keep for a long time, either liquid or dry, and as a kind of white powder (I possess specimens prepared in June, 1863).

The globular state may be produced by yolk of egg, bile, albuminous matters, &c.; for industrial purposes, it is produced by mixing tallow, melted at 45°, with water at 45°, holding in solution from 5 to 10 per cent. of soap.

2nd. Tallow, in the ordinary state, like other fatty bodies, resists washings in hot soda ley, and combines with it only with very great difficulty; in the globular state, on the contrary, it immediately absorbs this washing, in quantities varying with the temperature, so that it is possible, so to speak, to distend and contract each globule by lowering or raising the temperature between 45° and 60°.

It is easy to understand that in this case each globule of the fatty matter, attacked on all sides by alkali, abandons its glycerine with such rapidity as speedily to produce a liquid in which each globule is a perfect soap globule, inflated with lixivium. This can be effected in two or three hours.

3rd. These saponified globules, when exposed above 60°, gradually reject the lixivium with which they were distended, retaining only the quantity of water always entering into the composition of soap. They then become transparent, semi-liquid, and their confused mass forms a layer of melted soap above the lixivium, which retains the glycerine.

4th. The saponification of this mass is so complete that to extract the stearic acid it is only necessary to dilute the soap in cold water, and acidulate with a quantity of sulphuric acid proportioned to the soda. The fatty acids, mixed with water charged with sulphate of soda, may be separated by melting and pressing when cold, to obtain stearic acid, inodorous and fusible at from 58° to 59°, and almost colourless oleic acid.

These results, tested by industrial experience, recall the time when M. Chevreul, after his remarkable investigation of fatty bodies, believed that stearic acid could be economically produced with oleic acid. Unfortunately, all attempts to carry out this idea have failed.

Thus lime has been employed, the soap of which decomposes only by very strong measures, giving rancid, coloured oleic acids, whilst producing a loss in the deposits of sulphate of lime, without counting a number of costly operations; then came distillation, which increased the loss from 10 to 15 per cent., and lowered the value of the product, so much that one part of stearic acid disappeared and the oleic acid was rejected on account of its odour, its colour, and its inapplicability for making an agreeable soap; then came the splitting up of the fatty body by water under pressure; but then the incomplete saponification and diffused crystallisation became an obstacle to all subsequent operations. Finally, instead of pure water, a small proportion of lime, soda, or soap was put in the digester. The saponification still remained incomplete; the decomposing and pressing operations gave the same results in this as in the preceding instances, yielding only a kind of stearic acid, with a very low fusing point, and a red oxidised oleic acid to the value of 85 or 88 frs., while the olive oil was worth 130 and 135 frs. (These various operations have been described by MM. Pelouze, Tilman, Melsens, Podwer, &c.)

In the new operation all this is reversed; the loss is *nil*, being limited to the subtraction of the glycerine; the quantity of fatty acids obtained is 96—97 per cent. The operation is carried out in a single day; thus, operating on 2000 kilogrammes, three hours are required for the saponification, one hour for the decomposition, three hours for the fusion and settling, for the crystallisation eight hours, for pressure when cold in a double press four hours, making altogether nineteen hours for the operation; and as the crystallisation takes place in the night, there is in effect only eleven hours' work.

By this simple method we effect not only great economy in labour, fuel, and product, but also, thanks to the lowness of the temperature throughout, we obtain an inodorous, unaltered stearic acid, fusible at 58°—59°, and an oleic acid, equal, if not superior, to the best oils used in soap making.

It is obvious that this manufacture is revolutionised. Fatty bodies are now treated to produce stearic acid, leaving oleic acid as residue; in future, the same fatty bodies will be treated to obtain oleic acid, and the price of stearic acid will be lowered by the value of the oleic acid obtained.

Thus M. Chevreul's prognostications will be realised, and the products of France, where this manufacture originated, will no longer be inferior to those of foreign countries.

Soaps.—The best white soap may be made from pure oleic acid, either alone or mixed with other oils. None but neutral oils can be used, such, for instance, as are now used for Marseilles soap. In the first case—that is to say, when oleic acid only is used, the glycerine being removed—it suffices to saturate this acid by a feeble washing. The soap globules form immediately, and no delay is required before fusing them. On the contrary, when oleic acid is mixed with other oils, or when only neutral oils are employed, the process described for suet is used. The fatty bodies are converted into the globular state, the globules being kept in motion by a hot and salt lixivium until complete saponification. The saponified globules are separated by fusion, the soap is melted, separated from the lixivium, and poured into the moulds, where it solidifies by cooling. The operation requires six hours' effective work, and in twenty-four hours a soap is obtained as perfect, as neutral, and lathery as old Marseilles soap. (The specimens of silk presented to the Academy had been comparatively treated at the Gobelins manufactory with Payen's white Marseilles soap more than eight months old, and with soap made only three days by the process above described.) Saving of time is not the only advantage of this process. It is obvious that each globule, being separately attacked both inside and out, without becoming agglomerated or cooked *en masse*, no portion escapes saponification. Moreover, caustic soda, acting at a medium temperature, does not alter the fatty bodies, as in the ordinary processes, in which part of the oils is carried off in the coloured and frothy lixivium, thus entailing a notable loss.

It results, then, that in twenty-four hours a soap can be made, in greater quantities, as pure, as neutral, whiter, and lathering better than the best white Marseilles soap, requiring for its manufacture thirty or forty days, and then kept several months. These researches I hope will tend to check the introduction of a host of injurious products sold under the name of soap to the injury of the needy population; and I further hope that the manufacture of soaps and of stearic acid may be raised from the comparatively present low state into which it has fallen.—*Comptes Rendus*, lviii., 864.

PHYSICAL SCIENCE.

Cohesion Figures of Liquids by Submersion.

In the current number of the *Philosophical Magazine* Mr. Tomlinson has introduced a new set of figures under the above title, formed, not by placing a drop of the liquid on the surface of water, as in his former experiments (Chemical News, vol. ix., pp. 79 and 96), but by allowing the drop to sink below the surface before the figure is developed. In this way a large number of figures of great variety and beauty have been produced by allowing drops of various oils, solutions, and other liquids to subside in columns of water, spirits of wine, ether, turpentine, paraffine oil, benzol, and pyroligneous ether. For example, a solution of cochineal (from 20 to 40 grains in one fluid ounce of distilled water and filtered) forms admirable figures in a column of water contained in a glass cylinder eleven inches high and three inches in diameter, into which about half an ounce of solution of ammonia or a little alum water had been poured. If river water be used the lime is thus thrown down, so that the water should be allowed to stand a few hours before performing the experiment; or if distilled water be employed, the ammonia and the alum, by their chemical action on the cochineal, add to the beauty of the result. As soon as the drop of cochineal solution (delivered gently from a pipette) falls beneath the surface, it expands into a ring, sinks a short distance further, and then becomes poised. The more diffusive portions of the colouring matter stream upwards in a faint flame-like circular cloud; the denser portions accumulate at two opposite points of the ring, which is thus at its thinner portions bent upwards, and then drawn downwards into graceful festooned lines by the heavier portions, which form separate rings smaller than the parent ring. These rings, in like manner, descend. The denser portions of colouring matter accumulate at the two opposite points, 90° from the points of attachment to the festooned lines. Each small ring is, in this case, also bent upwards, while it drops two other rings, which in their turn go through the same series of changes, until the figure becomes almost too complicated to follow. This is a very common result with a moderately weak solution of cochineal. With a stronger solution the figure undergoes some beautiful modifications. The heavier portions of the colouring matter collect not at two, but at four, six, or even seven or eight points of the ring, bending it upwards in as many curved lines, and letting drop as many rings, each of which becomes the seat of manufacture of two rings; and in this polypus method of division and subdivision the colouring matter is diffused through the solution.

A more complicated figure, on the above type, is formed by allowing a drop of oil of lavender (from the end of a glass rod) gently to subside beneath the surface of spirits of wine contained in a cylindrical glass six inches high and one inch and a quarter in diameter. Oil of cubebs or of cinnamon forms good figures. The oils of turpentine and of juniper, as well as fixed oils, form flat spheroids. The appearance of the figures depends upon the solubility of the liquid employed. In some cases they are glassy or saccharine, in others chalky or milky, arising from the elaiopten of the essential oils being first dissolved, while the stearopten is left to do the work of the figure. When a column of benzol was used, many of the essential oils formed these opaque white figures. Oil of winter-green, turpentine, camphorated spirit, oil of bitter almonds, &c., formed good figures; the fixed oils formed discs with waving edges or cup-shaped vessels, which became drawn out in descending. In a column of paraffine oil some remarkable figures were produced with absinthe, neroli, and fousel oils. With the last-named oil the drop first forms a disc bagging downwards, and this almost immediately expands upwards, swells out into a dome or cone, the ring expanding all the time; the point of the cone remains fixed in the liquid, while the lower edge becomes arched at four equidistant points, the edges of the arches beautifully fringed, and lets fall lines with drops at the ends, which form separate cones, each of which becomes arched, and lets down other lines with drops. In this way a figure is produced of great beauty, and with an architectural kind of effect which is very striking. The duration is also considerable. The texture of the figure is gauze-like and delicate. A number of figures were obtained when a column of turpentine was used; a still larger number in a column of pyroligneous ether, some of which were chalky and very persistent. A drop of water flashed into a ring, descended, and expanded in rolling on its curved axis somewhat after the manner of a bubble of phosphuretted hydrogen bursting in air. In a column of ether those drops that did not immediately enter into solution formed beautiful rolling rings,—this was the case with drops of benzol and of the oils of turpentine and cajeput.

These liquid rolling rings led to an investigation of the phosphuretted hydrogen rings in air, which the author thinks have not been correctly explained in our text-books. The nearest approach to a correct explanation is that given by Professor Rogers in the *American Journal of Science* for September, 1858; but his explanation, which is not very precise, is embarrassed by conditions depending on the form of the orifice of the vessel from which the ring was projected, the tension of the enclosed gas, the chemical action, and, in the case of a liquid ring, the force with which the liquid is projected into a column of water, &c. Very fine liquid rings can be formed by allowing a saturated solution of common salt or of Epsom salts to drop slowly into a tall column of water from a height of about two inches.* The liquid

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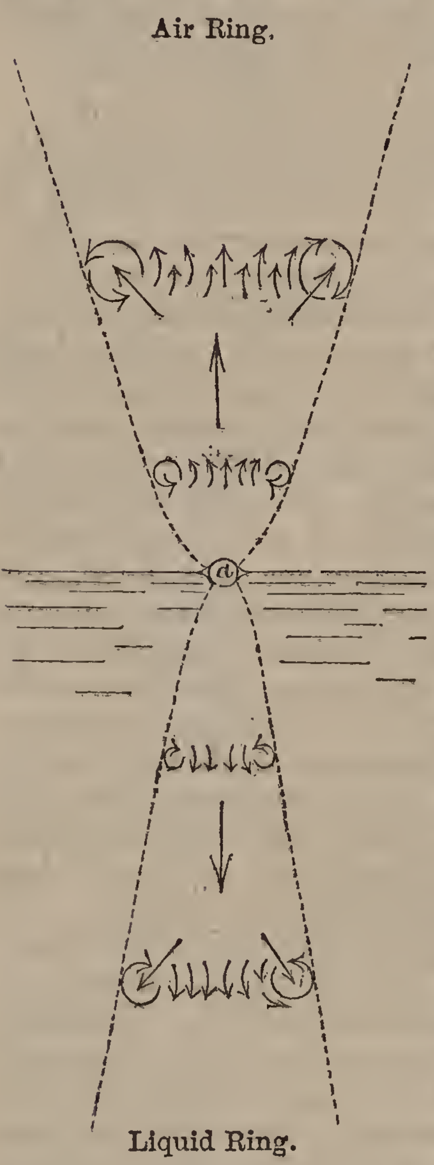
* The funnel containing the solution should be supported over the vessel, and the required slowness in the falling drops may be ensured by two or three folds of filtering-paper, or by first putting some of the salt into the filter.

rings thus formed roll rapidly round their curved axes, and go on expanding nearly to the bottom of the vessel before they disappear. Two ionic-like volutes are seen on either side of the rings; these are produced by the perspective of a number of rings seen through, or nearly through, each other, while at the front and back the edges of single rings only are seen. The formation of these rings is thus explained :—

“In the case of a liquid ring the forces are—(1) diffusion, which forms the ring; (2) gravity, which causes it to sink. The resistance is friction retarding (1) the descent of the ring, (2) its diffusion. In the case of a ring of smoke, the forces are precisely the same, only gravity causes it to ascend, and friction retards the ascent. I have attempted to combine both cases in the figure, where the globule a may be either a bubble of PH_3, about to burst and project a ring of smoke into the air, or it may be a drop of liquid about to descend in water, benzole, ether, &c. The ring of smoke, or the liquid ring, acts as if rolling up or down the inside of a hollow cone, and the direction of rotation of the particles will be found according to this view. In both cases the tendency of the ring is constantly to enlarge by diffusion, and the rate at which it does enlarge is regulated by the resistance of the liquid column or of the air. The resistance of the liquid column is much greater for the liquid ring than of the air for the smoke ring; and hence the liquid rings do not expand much, while the smoke rings expand greatly. But the resistance, whatever its amount, must clearly be applied to the outer surface of the ring; or the ring may be said to bear on the surrounding medium by its outer surface, which would be equivalent to its rolling up the inner surface of a hollow cone. In the figure, the straight vertical arrows show the motion of the ring up or down, the oblique arrows give the direction of the resultant of the forces acting on the ring, and the direction of the resistance of the medium to this resultant, while the curved arrows show the direction in which rotation must occur according as the general direction of the movement of the rings is upwards or downwards.”



Aerial rings on a grand scale may sometimes be seen from a factory chimney, the funnel of a steamboat, or the chimney of a locomotive. A friend writing to Mr. Tomlinson says :—

“As I was watching a goods train on the line last evening making its way with difficulty up an incline, the engine suddenly shot out from the funnel a beautiful ring of rippled smoke and steam, which separated itself from the general cloud of steam coming from the funnel and rose in the air unbroken and distinct. It was visible until it had gained a height of fifty feet or more. I was too far off to see its rotation; the ring, however, was admirably clear, and kept its form and size unchanged until it became invisible from condensation. We have had frequent rifle practice, but I have not seen a ring made yet from the smoke of the gunpowder.”

Investigations on the Specific Heat of Solid and Liquid Bodies, by Hermann Kopp, *Ph.D.**

The author commenced this paper with an historical report, giving a complete analysis of the various opinions already published on the subject. He then proceeded to describe the method he has used for determining the specific heat of solid bodies. This method is based on the method of mixtures. The substance investigated is placed in a glass tube, together with some liquid which does not dissolve it, and the tube is heated in a mercury bath, and then rapidly immersed in a calorimeter containing water. Equalisation of temperature takes place rapidly through the intervention of the liquid in the tube. The thermal effect (increase of temperature in the water of the calorimeter) is determined. Preliminary experiments give the means of allowing for the thermal effect due to the glass and to the liquid in it, and of thereby obtaining the thermal effect produced by the solid substance. The entire method (of which we hope to give a full account) is very simple, and it brings the determination of specific heat out of the restricted sphere of the physical cabinet, with its complicated apparatus, within reach of the ordinary appliances of the chemical laboratory. It is also applicable to small quantities, and to such substances as cannot bear a high temperature.

The author then gives his determinations of a very great number of solid bodies whose specific heat had not been previously determined; they extend to all the more important classes of inorganic compounds, and to a great number of organic compounds.

In the fourth part the author gives for solid bodies of known composition the atomic formula, the atomic weight, the more trustworthy determinations of specific heat, and, corresponding to these, the atomic heats, or products of the specific heats and the atomic weights.

The relations between the atomic heat and the atomic weight, or the composition, are next discussed, preceded by a discussion whether the specific heat of a body varies materially with its different physical conditions. The influence which change of temperature of solid bodies exerts on the specific heat is considered. This difference is inconsiderable, as is also the difference of specific heats found for the same substance, according as it is hammered or annealed, hard or soft. With dimorphous varieties of the same substance, even where the specific gravity is different, the same specific heat is found in most cases. Great difference had been supposed to exist in the specific heat of a substance, according as it was crystalline or amorphous. Dr. Kopp shows that, for a great number of substances, there is no such difference, and that in other cases the apparent differences depend on inaccurate determinations of the specific heat. He shows also that three sources of error may give too great a specific heat for a substance, or for one of its various modifications :—

1. When the substance is heated to a temperature at which it begins to soften, and thus to absorb part of its latent heat of fusion.

2. If the substance is heated to a temperature at which it begins to pass into another modification; and

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* Abstract of a paper read before the Royal Society, May 12, 1864.

this change, with its accompanying development of heat, is continued in the calorimeter.

3. If the substance investigated is porous, and (as was the case in the earlier methods) is directly immersed in the liquid of the calorimeter, in which case the development of heat which accompanies the moistening of porous substances comes into play.

The author arrives at the following results:—From what is at present known with certainty, one and the same body may exhibit small differences with certain physical conditions (temperature, or different degrees of density or porosity); but these differences are never so great as to furnish an explanation of cases in which a body markedly deviates from a regularity which might perhaps have been expected for it, always assuming that the determination of the specific heat, according to which the body in question forms an exception to the regularity, is trustworthy and free from foreign elements.

The author then discusses the applicability of Dulong and Petit's law. The atomic heats of many elements† are, in accordance with this law, approximately equal; they vary between 6 and 6·8, the average being about 6·4. The explanations attempted why this law only approximately holds good, he considers inadequate. In any case there are individual elements which do not obey this law. The atomic heat of phosphorus, for instance, as deduced from direct determinations of its specific heat in the solid state, is considerably smaller (about 5·4), and still more so are those of silicium (about 4), of boron (about 2·7), and of carbon (1·8 for diamond).

A regularity, to which attention has been already drawn, is, that the quotient obtained by dividing the atomic heat of a compound by the number of elementary atoms in one molecule, is approximately equal to 6·4; equal, that is, to the atomic heat of an element according to Dulong and Petit's law. Thus the atomic heat of the chlorides RCl and ɌCl has been found to be 12·8 on the average, and of the chlorides $\text{RCl}_2 = 18{\cdot}5$. Now $\frac{12{\cdot}8}{2} = 6{\cdot}4$, and $\frac{18{\cdot}5}{3} = 6{\cdot}2$. The same regularity is met with in metallic bromides, iodides, and arsenides; and according to the author's determinations, it is even found in the case of compounds which contain as many as seven, and even of nine elementary atoms. The atomic heat of $\text{Ƶn}\text{K}_2\text{Cl}_4$ is 43·4, and that of $\text{Ꝑt}\text{K}_2\text{Cl}_6$ is 55·2; now $\frac{43{\cdot}4}{7} = 6{\cdot}2$, and $\frac{55{\cdot}2}{9} = 6{\cdot}1$. But the author shows at the same time that this regularity is far from being general. For the oxides of the metals the quotient is less than six; and is smaller the greater the number of atoms of oxygen in the oxide. (From the average determinations of the atomic heats it is, for the metallic oxides $\text{Ɍ}\Theta_1 = \frac{11{\cdot}1}{2} = 5{\cdot}6$; for the oxides $\text{R}_2\Theta_3$ and $\text{Ɍ}_2\Theta_3$ $\frac{27{\cdot}2}{5} = 5{\cdot}4$; for the oxides $\text{Ɍ}\Theta_2 = \frac{13{\cdot}7}{3} = 4{\cdot}6$.) The quotient is still smaller for compounds which contain boron as well as oxygen (for instance, it is $\frac{16{\cdot}8}{4} = 4{\cdot}2$ for the borates, $\text{RB}\Theta_3$; it is $\frac{16{\cdot}6}{5} = 3{\cdot}3$ for boracic acid, $\text{B}_2\Theta_3$), or which contain silicium (for silicic acid, $\text{Ꞩi}\Theta_2$, it is $\frac{11{\cdot}3}{3} = 3{\cdot}8$), or hydrogen (for ice, $\text{H}_2\Theta$, it is $\frac{8{\cdot}6}{3} = 2{\cdot}9$); or, finally, which contain carbon and hydrogen as well as oxygen (for succinic acid, $\text{Ꞓ}_4\text{H}_6\Theta_4$, for instance, it is $\frac{36{\cdot}9}{14} = 2{\cdot}4$). It may be stated in a few words in what cases this quotient approximates to the atomic heat of most of the elements, and in what cases it is less. It is near 6·4 in the case of those compounds which only contain elements whose atomic heats, in accordance with Dulong and Petit's law, are themselves approximately = 6·4. It is less in those compounds containing elements which, as exceptions to Dulong and Petit's law, have a considerably smaller atomic heat than 6·4; and which are found to be exceptions, either directly, by determinations of their specific heat in the solid state, or indirectly, by the method to be subsequently described.

After Dulong and Petit had propounded their law, Neumann showed that a similar regularity existed in the case of compounds, that is, that the atomic heats of analogous compounds are approximately equal. Regnault, as is known, has confirmed Dulong and Petit's, as well as Neumann's law, to a considerably greater extent, and for a larger number of compounds, than had been previously done. And Regnault's researches have more especially shown that the elementary atoms, now regarded as monequivalent, are, as regards the atomic heat of their compounds, comparable with the elementary atoms which are to be considered as polyequivalent. Thus, as regards atomic heat, arsenious acid, $\text{As}_2\Theta_3$, and sesquioxide of iron, $\text{Ꞙe}_2\Theta_3$, or chloride of silver and subchloride of copper, $\text{Ꞓu}\text{Cl}$, may be classed together. Of the applicability of Neumann's law, as hitherto investigated and found in the case of chemically analogous compounds, the author's experimental determinations have furnished a number of new examples. But more interest is presented by his results in reference to the applicability of this law to compounds, to which it had not hitherto been supposed to apply.

In comparing compounds as regards their atomic heat, their chemical character has been taken into account, as represented by the formulæ hitherto adopted. Sulphates and chromates, for instance, were looked upon as comparable, but they would not have been classed with perchlorates, or with permanganates. According to more recent assumptions for the atomic weights of the elements, the following salts have analogous formulæ, and the adjoined atomic heats have been determined:—

Chromate of lead . . .	$\text{Ꝑb}\text{Ꞓr}\Theta_4$	29·0
Sulphate of lead	$\text{Ꝑb}\text{Ꞩ}\Theta_4$	25·8
Permanganate of potass . .	$\text{K}\text{M̶n}\Theta_4$	28·3
Perchlorate of potass . . .	$\text{KCl}\Theta_4$	26·3

The atomic heats of carbonates, $\text{Ɍ}\text{Ꞓ}\Theta_3$, of silicates, $\text{Ɍ}\text{Ꞩi}\Theta_3$, of metaphosphates, $\text{RP}\Theta_3$, of nitrates, $\text{RN}\Theta_2$, are also very near.

But not even a common chemical behaviour, such as the bodies in this group possess, that is a common haloid character, is necessary in order that compounds of analogous atomic composition shall show the same atomic heat. No one would think of considering magnetic oxide of iron as analogous to chromate of potass, and yet both have the same atomic structure, and determinations of their specific heat have given approximately the same atomic heat for both.

Magnetic oxide of iron . .	$\text{Ꞙe}_3\Theta_4$	37·7
Chromate of potass . . .	$\text{K}_2\text{Ꞓr}\Theta$	36·4

And it is not less surprising that arseniate of potass, $\text{KAs}\Theta_3$, and chlorate of potass have the same atomic

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† In accordance with recent assumptions for the atomic weights, H = 1; Cl = 35·5; Θ = 16; Ꞩ = 32; B = 10·9; Ꞓ = 12; Ꞩi = 28. R stands for a monoequivalent atom, *e.g.*, As = 75; Na = 23; K = 39·1; Ag = 100; Ɍ signifies a polyequivalent atom, *e.g.*, Ꞓa = 40; Ꝑb = 207; Ꞙe = 56; Ꞓo = 63·4; Ꞓr = 52·2; Ꝑt = 184, &c.

heat as sesquioxide of iron, $Fe_2\Theta_3$, or arsenious acid, $As_2\Theta_3$; with very different characters these compounds have approximately equal atomic heat.

But comparability of chemical compounds, as regards the atomic heat, is not limited to the cases in which, as far as can be judged, the individual atoms have analogous construction. We do not regard the atom of binoxide of tin or of titanic acid as analogous in construction to the atom of tungstate of lime or of chromate of lead; nor to nitrate of baryta, or metaphosphate of lime. But if the formulæ of these binoxides are doubled or tripled, they may be compared with those salts, and their atomic heats are then approximately equal, as is the case for compounds of analogous chemical character. The atomic heats are for—

Binoxide of tin . .	$2\text{Ꞩn}\Theta_2 = \text{Ꞩn}_2\Theta_4$	27·6
Titanic acid . . .	$2\text{Ŧi}\Theta_2 = \text{Ŧi}_2\Theta_4$	27·3
Tungstate of lime	$\text{Ȼa}\text{W}\Theta_4$	27·9
Chromate of lead	$\text{Ᵽb}\text{Ȼr}\Theta_4$	29·0
Permanganate of potass. . .	$\text{KnM}\Theta_4$	28·3
Perchlorate of potass . . .	$\text{KCl}\Theta_4$	26·3
Binoxide of tin , .	$3\text{Ꞩn}\Theta_2 = \text{Ꞩn}_3\Theta_6$	41·4
Titanic acid . . .	$3\text{Ŧi}\Theta_2 = \text{Ŧi}_3\Theta_6$	41·0
Nitrate of baryta	$\text{Ƀa}N_2\Theta_6$	38·9
Metaphosphate of lime . . .	$\text{Ȼa}\text{Ᵽ}_2\Theta_6$	39·4

These results seem to give to Neumann's law a validity far beyond the limits to which it had hitherto been considered to apply. But, on the other hand, the author's comparisons go to show that neither Neumann's nor Dulong and Petit's law is universally valid.

Neumann's law is only approximate, as is well known. For such analogous compounds, as from what we know at present, are quite comparable, and in accordance with this law ought to have equal atomic heats. Regnault found the atomic heats differing from each other by one-tenth to one-ninth. In a few such cases there are even greater differences in the atomic heats, for which an adequate explanation is still wanting.

But there are other differences in the atomic heats of some compounds which might have been expected to have equality of atomic heat in accordance with Neumann's law, differences which occur with regularity, and for which an explanation is possible. Certain elements impress upon all their compounds the common character, that their atomic heats are smaller than those of analogous compounds of other elements. This is the case, for instance, with the compounds of boron; the atomic heat of boracic acid is much less than that of the metallic oxides, $R_2\Theta_3$ and $\text{Ɍ}_2\Theta_3$; the atomic heat of the borates, $RB\Theta_2$, is much less than that of the oxides, $\text{Ɍ}_2\Theta_2 = (2\text{Ɍ}\Theta)$, and the atomic heat of borate of lead, $\text{Ᵽb}B_2\Theta_4$, is far less than that of magnetic oxide of iron, $\text{Ꞙe}_3\Theta_4$. The same is the case with compounds of carbon, if the alkaline carbonates $\text{Ɍ}_2\text{Ȼ}\Theta_3$, are compared with the metallic oxides, $\text{Ɍ}_3\Theta_3 = (3\text{Ɍ}\Theta)$, or the carbonates, $\text{Ɍ}\text{Ȼ}\Theta$, with the metallic oxides, $\text{Ɍ}_2\Theta_3$ and $\text{Ɍ}_2\Theta_3$. It is seen that the compounds of those elements which, in the free state, have themselves a smaller atomic heat than most other elements, are characterised by a smaller atomic heat.

(To be continued.)

Permanent Stratification produced by the Spark of Induction; new arrangements of the Interrupters, by M. l'Abbé Laborde.

Several physicists have investigated the stratified light of the electric spark, and have assigned various causes for this curious phenomenon. The various researches on this subject have ended in establishing beyond doubt one fact only, that the alternately light and dark bands are formed in a ponderable matter. I have succeeded in producing, on a semi-conducting surface, an analogous stratification; transverse rays whose durable impression no doubt will facilitate the study of this phenomenon.

To prepare this semi-conducting layer, pour on a glass plate some iodised collodion, and then let it undergo all the operations necessary to produce a photographic plate. A suitable surface cannot invariably be obtained. The layer, in fact, does not conduct the electricity when the reduction of the silver is not sufficiently advanced, and the spark passes over without attacking. This is generally the case with solarised surfaces with a reddish tint. If, on the contrary, the silver is completely reduced, and presents a metallic and mirror-like layer, it conducts too well, and the spark traverses without modifying it. Between these two extremes surfaces are obtainable more or less conducting, on which the spark produces more or less compact strata, of very varied appearance.

They are not regular, like the bands of light formed in a perfectly homogeneous medium, but, whatever their form, they always appear transversely to the spark; in all my experiments I have not found a single exception.

These designs, traced by electricity on an opaque surface, are transparent, which allows of their reproduction directly on a paper prepared with chloride of silver. Manifold details are lost in this operation which the microscope reveals on the negative plate.

In practising photography, so many negative plates are rendered useless that the simplest way is to use them for the trials, instead of preparing others expressly; and it is very uncommon to be unable to find a suitable surface, especially among negative plates on which the image has been developed by pyrogallic acid; the varnish which covers them being no disadvantage. The two ends of the induction wire are placed a little distance apart on the surface, and, according as it is more or less conducting, the spark produces stratification on it in a few seconds or a few minutes.

The strata are inflected towards the poles like stratified light in vacuo, with a characteristic difference by which the positive and negative poles can always be distinguished. Towards their extremities there takes place always a peculiar arborisation, and the bodies of the strata, examined under the microscope on the negative plate, seem formed of finer and more compact arborisations. By studying, for the purpose of finding them, the bands of light produced in a vacuum, some similar arrangement will perhaps be found; in fact, a sort of vibration is observable, which may result from each spark without effecting any change in the general form, producing a different arborisation.

The stratifications always commence at the negative pole and extend progressively to the positive pole. The following experiment makes apparent this property of the negative pole:—The two ends of the induction wire being placed on a semi-conducting surface, withdraw from time to time the negative extremity. The spark, opening a way for itself, may thus extend to sufficiently considerable distances, and each point of stoppage of the negative wire is marked by an arborescent stratum, which continues to develope itself under the induced current. A different effect is produced by now and then withdrawing the positive wire, the negative wire remaining stationary.

Certain surfaces are very readily attacked by the spark. The stratifications are then more compact, and are produced from one pole to the other immediately. If the current is continued they are developed and encroach one upon the other; but although in the end confused, an experienced eye can still distinguish that they have existed.

When the ends of the induction wire do not touch the surface, but project the spark to a distance, the design is not so easily produced, and presents a peculiar appearance. The stratifications are less marked and less arborescent. This is perhaps occasioned by the induction current on closing the circuit being suppressed, so that only the induction current formed when the circuit is opened exerts its action.

The spark often deviates from the straight line, and when persisting to the right or left adds lateral stratifications to the principal figure.

I have tried the spark of the ordinary electric machine, and found that it also produced transverse rays; but it penetrates with more difficulty than the induction spark, and remains long on the surface. An easily attacked surface should be selected, and the action should be prolonged so as to produce a sufficiently fine result.

I used a mercury interrupter, which presents a special advantage; it is now known that the soft iron of the electro-magnet does not immediately acquire its full power, either because it opposes a certain resistance to magnetism, or because, in the first instance, the effect of the principal current is opposed by the counter current which it engenders. In automatic interrupters the contact is hardly established when it is broken by the attraction of the soft iron before it could attain the maximum of magnetism. In the interrupter about to be described, the part touching the mercury instead of severing from it by the attraction of the soft iron, sinks, on the contrary, still deeper, and severs from it an instant afterwards. It is composed of a small bar of soft iron, traversed in the centre by a horizontal axis on which it turns, presenting its extremities alternately to the soft iron of the electro-magnet. A small wheel fixed on the axis is furnished with two teeth inclined opposite to each other. These teeth, or small inclined planes, raise by turns the extremity of a lever oscillating on an axis, and plunges the other end in the mercury, upon which alcohol has been poured. The communication is thus properly effected; the excited electro-magnet attracts the superior end of the little bar, and before it has passed the line of force the inclined tooth escapes the lever, which is pushed by a spring away from the mercury. The same effect is produced when the bar presents its other extremity to the electro-magnet, and, if unopposed, assumes a very rapid rotatory movement. The induced sparks do not succeed each other so promptly as with the hammer interrupter; but they are more regular, brighter, and longer.

I have modified the hammer interrupter in a way which renders it more efficacious. Its iron rod is surrounded with three layers of thick wire covered with silk; one of the ends is soldered to the head of the hammer, and the other is fastened by a moveable communication to the inducting wire towards the hinge at the handle of the hammer. The current then passes, not by the rod, but by the wire surrounding it, and is so directed that the hammer receives a contrary magnetism to that of the soft iron of the apparatus. The attraction becomes stronger, and in spite of the increased weight of the hammer more tension can be given to the spring pressing against the magnet. The result is more intimate contact and more complete action with each movement.—*Comptes Rendus*, lviii. 661.

PHOTOGRAPHY.

On the Application of Potassio-Ammonium Chromate to Photography, by M. E. Kopp.

Potassio-ammonium chromate, whether pure or with the addition of an ammonium salt, the acid of which may vary as the operator wishes, more or less, to modify the reaction, is an excellent photographic agent, since the undecomposed salt will not attack cellulose. It is especially useful for obtaining positive images from negatives prepared by the ordinary processes.

The paper may be impregnated with a concentrated solution of the salt, and left to dry in the dark at the ordinary temperature without undergoing any alteration.

The paper remains yellow, and it is only after a long time, and very gradually, that it assumes an orange-yellow tint. It remains active for a considerable time.

But on exposure to daylight, and especially to the direct rays of the sun, the paper thus prepared soon acquires a brown colour, becoming deeper and more intense.

By covering the prepared paper with an engraving and then with a plate of glass, so as to press the engraving on to the paper, after a few minutes' exposure to the solar light, a very distinct negative image will appear. If the engraving is previously oiled, or an ordinary collodion negative is used, two or three minutes' exposure to the solar rays will produce a very defined effect.

By washing the paper in pure water or acidulated with one or two drops of acid, the unaltered chromate is dissolved; the image is then fixed, and may, without fear, be dried in the light.

The washing must not, however, be prolonged more than is absolutely necessary, if it is desired to preserve the characteristic yellowish-brown tint, nor must the picture undergo further treatment.

There seems no doubt that potassio or sodio-ammonium chromate may advantageously replace bichromate of potash in all photographic processes in which the latter salt is used, as, for instance, in gelatine, carbon, &c., photographs.

The reaction producing the image, and the behaviour of the latter, under considerably varied and interesting circumstances, may be easily explained.

Under the influence of light the potassio-ammonium chromate loses its ammonia, becomes acid, and the chromic acid then reacting on the cellulose, partly oxidises it, and is, at the same time, reduced to brown chromic peroxide—CrO_2.

This peroxide $CrO_2 = Cr_3O_6 = CrO_3,Cr_2O_3$ may also be considered as a chromate of chromium—that is to say, as resulting from the combination of chromic acid with green oxide of chromium, and, in fact, even with feeble affinities it is separated readily into chromic acid and oxide of chromium.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 2, 1864.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

In continuation of our report of Professor Stokes's discourse "*On the Detection and Discrimination of Organic Bodies by Means of their Optical Properties*," we proceed with the lecturer's description of the optical characters of chlorophyll, the green colouring matter existing in plants. Although little is known as yet regarding the nature and composition of chlorophyll, the author considered there were sufficient grounds for believing that this green pigment was really made up of two separate principles, or kinds of colouring matter, which exhibited distinct optical properties; thus, one of the components showed in the spectrum a group of bands between F and G, whilst the optical character of the second body was much simpler. If green leaves were macerated for a short time with dilute alcohol the coloured infusion gave one band nearly coinciding with the line F, and another between F and G, but when bisulphide of carbon was used as the solvent the two bands were shifted nearer the red end of the spectrum to the extent of one band interval. If a mixed solvent were employed the group occupied an intermediate position; and the addition of an acid to the sulphide of carbon solution moved the bands back again to the same position as they were found to occupy in the alcoholic extract. The author then described the character of fluorescence as exhibited by quinine, "leaf green," fluor spar, and a variety of vegetable organic substances. When the bright rays of the sun or of the electric spark were allowed to fall upon the surface of an aqueous solution of a quinine salt, it was well known that a brilliant azure-blue colour was developed, which made its appearance not only under the blue and violet portions of the spectrum, but extended from a point midway between the fixed lines G and H for a considerable distance into the chemically active, but otherwise invisible, part of the spectrum. The production of these blue rays was quite independent of a decomposition of light in the incident beam, and the author had already shown that their appearance was due to a change of refrangibility of the light always on the side of diminution; whilst with leaf-green infusion, which showed a red fluorescence, the alteration in the degree of refrangibility, still in the same direction, was made apparent in a different manner. It was possible to observe simultaneously these optical effects, inasmuch as they occurred at different parts of the spectrum, if the precaution of taking a sufficiently diluted solution of the mixed substances were adhered to; that is to say, the absorption of the fluorescent light by too highly coloured a solution must of course in such a case be guarded against. By a series of coloured diagrams the author showed conclusively the manner in which he had proved fluorescence to be but the effect of a diminution in the degree of refrangibility, the blue rays of the solar spectrum were collected by a lens and passed throught a sufficient layer of the sensitive medium, the transmitted beam was then analysed by a prism and shown to consist of light of different degrees of refrangibility, but always inferior to that of the producing ray. The lecturer then proceeded to show some very beautiful experiments with a number of fluorescent substances, which were successively illuminated by the spark discharge of a Ruhmkorf coil, having a Leyden jar in circuit, and the power of window glass in cutting off the active rays was exhibited in comparison with a plate of quartz ·4 inch in thickness. The latter did not in any appreciable degree obstruct the passage of the fluorescent rays, whilst the window-glass, no more than ·1 inch thick, cut off nearly all. Among the substances thus experimented with were aesculin and fraxin, (the alkaloids contained in the bark of the horse-chestnut), purpurin from madder, which showed a yellow fluorescence, and solutions of terephthalic acid kindly furnished by Drs. De la Rue and H. Müller. The etherial solution of this last-named substance showed a bluish fluorescence, whilst the aqueous solution appeared green. By the optical examination of the permanganate of potash the lecturer discovered that the crystals by reflected light showed bands of maxima brilliancy exactly corresponding to the dark bands absorbed by the solution; it thus appeared that the crystallised salt partook of the optical characters of a metal and of a vitreous substance alternately. Similar quasi-metallic reflections were seen also in the platinocyanide of magnesium and in some of the crystallised aniline colours. In conclusion the author compared these results with the well-known observation that gold leaf showed a greenish hue by transmitted light, whilst it appeared of a rich yellow by reflected light; many other instances of notable variations in colour presented by chemical products would suggest themselves to his hearers.

The President, in proposing a vote of thanks to Professor Stokes (which was warmly responded to), commented upon the importance to be attached to the lecturer's remarks, both as regards methods and results. Much had already been accomplished towards extending the means of physical observation, and no research would be considered complete unless it comprehended a statement of the optical characters of the substances in question. The speaker concluded by inquiring of Professor Stokes whether he was acquainted with any instance of a substance undergoing decomposition during the process of solution?

Dr. Odling asked whether any good explanation, founded on optical tests, could be assigned in the case of the well-known fact that iodine when dissolved in alcohol or ether gave a brown solution, whilst with other solvents, particularly chloroform and bisulphide of carbon, the colour of the solution was violet? Whether there appeared to be any connexion between the mode of absorption characterised by iodine vapour and that of the bisulphide of carbon solution?

Professor Stokes, in reply to the President, mentioned the fact of the green chloride of copper becoming blue on dilution; but, in answer to Dr. Odling's inquiry, said he was not prepared to give any theoretical explanation of the facts alluded to.

The President requested, on the part of the Council, that Professor Stokes would be so good as to prepare an abstract of his communication for the purpose of being published in the Society's Journal.

Dr. Gladstone suggested that if the lecturer would kindly enlarge upon the subject he had in so interesting a manner brought before them, he felt sure the Society would consider themselves even further indebted to Professor Stokes.

The meeting was then adjourned until the 16th inst.

CHEMICAL GEOLOGY,

A Course of Twelve Lectures, by Dr. Percy, *F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.*

Lecture X.—*Saturday, January* 23.

(*Continued from page* 248.)

The first carbonaceous deposit we shall consider is peat or turf. This substance has played a very important part in this country as a fuel, and is still extensively used, but it is much more valuable in other countries which do not possess those magnificent deposits of coal occurring in this country, and which are being so terribly misused, owing to a want of economy in the burning of the fuel. Of that we will speak hereafter.

Peat is a product of the natural decay of various plants under special conditions of heat and moisture, and those special conditions occur in humid and temperate climates. Still we find peat in tropical regions, as I shall show you by-and-by. Immense accumulations of peat, as every one knows, exist in our peat-bogs in Ireland, and also in various parts of this country. It is abundant also in the central parts of France and other parts of Europe. It is found also in mountain declivities, where it seldom exceeds four feet in thickness. The peat of Europe is generally derived from mosses of the genus *sphagnum*—a very beautiful genus it is. Here we have a specimen of peat from the museum above; it was brought by Dr. Falconer from the bottom of a lake in Thibet. The remains of diatomaceæ have been found in it by Mr. Etheridge. This, again, is a variety of peat from the Neilgherry Hills in India.

It is certain that many peat-bogs occupy the sites of former forests, and sometimes we find in those bogs trees of large dimensions. I have here the names of some of the plants which have been found in Calcutta peat. Peat occurs there dug out a few feet below the surface of the soil. It contains remains of phænogamous plants.

As the peat is composed of the tangled remains of the plants from which it has been derived, a peat bog presents us with peat in various stages of decomposition. The decomposition is advanced, as we should naturally expect it would be, in proportion to the depth of the peat bog; so that when we take peat out from the bottom of a peat bog, it may present to the eye scarcely any visible trace of organic structure—plant structure—whereas we shall see the plant from which it has been formed growing on the surface luxuriantly. Between those two conditions—the living plant and the decomposed mass—we find every gradation.

The composition of peat is interesting in relation to that of wood. I will give it to you directly in a connected form.

In the ashes of peat, we find not only those inorganic elements which exist in the plants forming the peat, but clayey matter—silicate of alumina and so forth—which have been derived from extraneous sources. Bogs are subject, for example, to inundation, and sandy or clayey matter may be washed in, and so become intimately mixed with the peat. This has occurred also in the formation of many coal seams. I could take you down a pit where you may see the coal interspersed with sandstone, which has no doubt been produced in the way I spoke of—from the washing in by floods, or otherwise, of extraneous matter not forming part of the plants originally. Copper has been known to occur, and pretty abundantly, in the peat of North Wales, and we find also iron pyrites even to a large extent—to such an extent that it has been profitably used as a source of sulphate of iron, which is produced by the weathering action of the sulphide contained in the peat.

I need not trouble you with a complete analysis of peat. It contains a variety of very imperfectly known organic constituents—stuff called humic acid, and so forth.

The next deposit of carbonaceous matter of interest to us is coal. We all fancy that we know perfectly well what coal is, and that there would be no difficulty in constructing a suitable definition of coal; and yet it is probably one of the greatest difficulties one could have to solve to give such a definition of coal as would be unmistakably and perfectly applicable to all the substances we term "coal." The question gave rise to a very extensive and costly trial some time ago in Edinburgh, the results of which have been recorded in a quarto volume which we have in the library. It is quite amazing to see the varied opinions expressed on the subject. Numerous witnesses were examined—some chemists, some botanists, some mineralogists, some geologists, and some gas engineers, and the evidence was extremely conflicting, half a dozen witnesses saying one thing, and half a dozen another; so that the judge and jury were all puzzled, and the scientific evidence was altogether ignored. The judge took a common-sense view of this subject, but they could not succeed in producing a satisfactory definition of coal. Perhaps a near approach to a definition of coal would be the following:—We may define it to be "a solid mineral substance, more or less easily combustible, and varying in colour from dark brown to black; opaque, except in very thin slices; brittle; not fusible without decomposition; not sensibly soluble in ether or turpentine; and not containing sufficient earthy matter to prevent its being applied as a source of heat." You will see one difficulty about this in a moment. Coal in coal beds occurs along with shaley matter. Coal generally contains, as we shall see presently, a clay with which it is associated. We may get a coal which contains a considerable amount of shaley matter, and a shale which contains a considerable amount of carbonaceous matter. Now, I should like any one to tell me where the coal ceases and the shale begins. We may have a shale containing 1 per cent. of carbonaceous matter, and we may have others containing 2, 3, 4, 5, 6, or 10 per cent., and so on, till at length we get what people would call coal; but it is impossible, I think, to define exactly where the one begins and the other ends. There is no doubt as to the nature of peat, because we see the transformation from living vegetable matter to peat. Coal is also as certainly derived from vegetable matter. We find the remains of plants associated with the coal, above the coal, and below the coal. There is no question whatever about that fact.

Let me now direct your attention to the varieties of coal which occur. There are some points which I think you will admit to be of geological interest in connection with this part of our subject. We begin with woody tissue, pass on to peat, and then arrive at coal. We have a class of coal approximating to peat in composition, intermediate between peat on the one hand, and our true so-called bituminous coals on the other. To this intermediate description of coal the name of lignite has been given, or brown coal. We have valuable deposits of this lignite occurring at Bovey Tracey, in Devonshire. Lignite is found also in various other parts of the world. I have collected analyses of different sorts of lignite, and presented them in the form of a table. There is one point about them which is characteristic: they all contain, so far as my experience goes—I speak here of course with a certain degree of reservation—a considerable amount of hygroscopic water—much more than any true coal I ever saw—sometimes 15, 18, or 20 per cent.; and in so far these varieties of lignite resemble wood in a remarkable degree. All our common wood, dry as it may appear,—even this deal table which I now touch—contains a large amount of water, which may be displaced by exposing the wood to a temperature below that required to effect its decomposition. The volatilisation of water from wood, and its reabsorption from the air under different conditions, occasions that crackling which we hear in our furniture from time to time. The water of the lignite may be expelled by exposing the substance to a certain amount of heat, but on cooling and re-exposure to the air, it reabsorbs the water which it has lost.

We have bituminous coal, occurring in England, Staffordshire for example, which comes next in order after lignite. Then we have a steam coal from the Tyne, and at last the so-called anthracitic coal from Wales. I have drawn up a table so as to give you at a glance the comparative composition of all the typical varieties of coal. The figures are deduced from a very large number of analyses. I will take the carbon as represented by 100 in every case, so as to enable you to compare the successive changes in composition which take place from wood to coal. I will ignore the nitrogen as not a material item in our consideration.

	Carbon.	Hydrogen.	Oxygen.
Woody tissue	100	12·18	83·07
Peat.	100	9·85	55·67
Lignite	100	8·3	42·42
South Staffordshire coal . .	100	6·12	21·23
Steam coal from the Tyne. .	100	5·91	18·32
Semi-anthracitic coal from South Wales	100	4·75	5·28
Anthracite from Pennsylvania .	100	2·84	1·74

That table is drawn up with a great deal of care from a vast number of analyses, and it will give you at a glance the comparative composition of all these varieties of carbonaceous deposits from wood down to anthracite, which is the farthest removed from wood in composition. You see how beautifully gradual the change is all the way down. Mark the great diminution of oxygen in peat compared with the quantity contained in the woody tissue. You will, of course, understand with regard to lignite that the various lignites differ considerably in composition, but the analysis I have just presented to your notice is an average taken from the analysis of several varieties from different parts of the world. You see how the quantity of carbon creeps up as we get away from wood. The South Staffordshire coal, of which I have given you the composition, is of the same sort as occurs in some other parts of England. It is a free-burning coal, that is to say, it burns without caking together like our Newcastle coal, and produces a long flame. It is extensively used in Staffordshire, not only for household purposes, but also in metallurgical operations. There is a great diminution in the oxygen compared with lignite, and yet this variety of coal contains more oxygen than any other varieties of coal we have. The amount of oxygen is quite characteristic. I need hardly say that the less oxygen we have under ordinary conditions the better the coal, because the oxygen is almost all so much dead loss. The oxygen that we find in coal may be regarded as existing in combination with hydrogen in the state of water, and does not cause heat; but on the contrary, it has to be evaporated, and must cause a loss of heat. We have an abundance of anthracite from South Wales of nearly the same composition as the anthracite from Pennsylvania, of which I have given you the analysis.

We have all seen, in walking by a stagnant pool from time to time, little bubbles of gas starting up on the surface of the water. If we collected that gas and burned it, we should find that it is light carburetted hydrogen or marsh gas, containing more or less carbonic acid. In our coal mines we find that marsh gas exists in the coal much in the same way as condensed air exists in spongy charcoal. By abstracting from woody tissue certain proportions of hydrogen, carbon, and oxygen in the two states of carbonic acid and carburetted hydrogen, we can produce every variety of carbonaceous deposit, the composition of which I have represented to you in the table I have given.

ACADEMY OF SCIENCES.

June 6.

M. Payen has examined an old wooden wheel which General Morin found in an abandoned copper mine in St. Domingo. It was in an excellent state of preservation, though no one knows how old. M. Payen found the wood to contain a large amount of iron and some copper, to the presence of which its preservation must be attributed. This is a satisfactory confirmation of the value of a modern application—not very modern, however; for it seems that Pallas, in 1719, recommended wood to be saturated with green vitriol. It should be known that moisture is essential to the preservation. Wood, treated in this way and then exposed sometimes to a dry and sometimes to a moist atmosphere, soon decays.

M. Kulhmann contributed a memoir "*On the Crystallogenic Force,*" which, he seems to say, is a sort of molecular attraction governed by some general law, and which plays an important part in a great number of natural phenomena —a conclusion which we do not suppose anybody will dispute. The particular illustrations the author mentions do not seem to us important; but we shall quote the account of fluoride of thallium given in a note to the memoir.

Mr. Oppenheim contributed a paper "*On the Action of Bromine and Iodine on Allylene.*" The author has formed, and here describes, the bibromide, tetrabromide, and biniodide of allylene.

M. L. Grandeau contributed an important note "*On the Application of Dialysis to the Separation of the Alkaloids; and a New Test for Digitaline.*" Digitaline, it would seem, passes readily into the diffusate, which we should not have expected. A dilute solution evaporated to dryness and the residue treated with sulphuric acid gives a rose coloured spot. When exposed to the vapour of bromine this spot turns violet. In this way 0·0005 of a gramme of digitaline may be detected. The author adds a long list of alkaloids which do not give this reaction, and as the paper contains some other things of interest, we shall translate it at length.

A note by M. Dufour "*On the Ebullition of Water and the Bursting of Steam-Boilers*" contains a suggestion. Water when deprived of air, as Mr. Grove has shown, does not boil steadily, and hence the author thinks boiler explosions result. Let it be kept well supplied with air, then, by carrying into the boiler two platinum wires connected with a voltaic pile.

Some time ago M. L. Cailletet communicated a note "*On the Permeability of Wrought Iron by Hydrogen at High Temperatures.*" The gas passed through plates several millimetres thick, at a red heat; the author now shows that when cold, or at a temperature of 210° C., hydrogen will not traverse a plate of only $\frac{1}{35}$th millimetre thickness.

In a note by M. Reboul entitled "*On some non-Saturated Bodies belonging to the Group of Mixed Ethers,*" the author describes a compound resulting from the action of alcoholic potash on a bromated compound of amylene.

NOTICES OF BOOKS.

Journal für Praktische Chemie. No. 8. 1864.

The articles in this number are of no special interest, and we give only the titles. They consist of papers on Arfvedsonite, by Kobell; an account of some Analyses of various Gaseous and Fluid Volcanic Products; On Silico-fluoride of Lithium, by Stolba; Researches on the Beet-plant, by Hoffmann, of Prague. Of more interest to some chemists will be a series of short notices of some Compounds and Substitution Products of Aceton, by Dr. E. Mulder; and a paper by Rochleder on the Constitution of Organic Compounds, and the Origin of Homologous Bodies. A Method for the Estimation of Carbonic Acid in Mineral Waters, by L. Meyer, does not seem to possess much advantage over the methods in common use, and, moreover, is very troublesome.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

299. James Young, Bucklersbury, London, "Improvements in the preservation of vegetable and animal matters." —Petition recorded February 4, 1864.

1038. John Frederick Brinjes, Fieldgate Street, Whitechapel, Middlesex, "Improvements in apparatus for the reburning of animal charcoal."—Petition recorded April 23, 1864.

1179. Alfred Silvester, New Dorset Place, Clapham Road, Surrey, "An improved apparatus for obtaining certain theatrical effects."—Petition recorded May 10, 1864.

1278. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the construction of fuses for projectiles."—A communication from Arthur Anthoni Voruz, Rue St. Sebastien, Paris, France.—Petition recorded May 20, 1864.

1291. Matthew Piers Watt Boulton, Tew Park, Oxfordshire, "Improvements in engines worked by means of heated air or gases or steam, part of which invention is also applicable to compressing air and aeriform fluids."—Petition recorded May 24, 1864.

1296. Benjamin Jones, Warrington, Lancashire, "Improvements in the mode or method of obtaining sulphur from alkali or blue waste."

1300. George Shaw, Birmingham, Warwickshire, "Improvements in apparatus for heating the steam boilers of stationary, locomotive, and marine engines, for heating stoves, and for heating purposes generally."—A communication from August Conrad Dewies, Liège, Belgium.

1303. George Schaub, New Hanley Road West, Upper Holloway, Middlesex, "An improved mode of transmitting currents of electricity for telegraphic purposes."—Petitions recorded May 25, 1864.

1319. Arthur Wall, Clapton, Middlesex, "Improvements in purifying oils, in converting fatty, vegetable, mineral, or fishy substances into oils, and in the machinery or apparatus used therein."—Petition recorded May 27, 1864.

1325. John William Lees, Waterhead Mill, near Oldham, Lancashire, "Certain improvements in the method of cleaning and preventing the formation of deposits upon the heating apparatus employed in boilers generating steam."

1327. John Thomas, Battersea, Surrey, "An improved paint."—Petitions recorded May 28, 1864.

1349. James Young, Bucklersbury, London, "Improvements in the treatment or distillation of bituminous substances."—Petitions recorded May 31, 1864.

1355. Richard Edward Donovan and Robert Bowles, Dublin, "Improvements in the means for the prevention of fraud by altering cheques, drafts, bills, I O U's, and documents of any description relating to the payment and receipt of money."—Petition recorded June 1, 1864.

Notices to Proceed.

202. John Piddington, Gracechurch Street, London, "Improvements in the manufacture of paper from straw and other analogous vegetable fibrous substances."—A communication from Augustus Henry Tait, William Henry Holbrook, and Asahel Knowlton Eaton, U.S. America.—Petition recorded January 23, 1864.

249. Bryan I'Anson, Bromwich, Birmingham, Warwickshire, "Improvements in the construction of casks or vessels for the storing of wines, spirits, and other liquids or fluids."—Petition recorded January 29, 1864.

260. Edward Thomas Hughes, Chancery Lane, London, "Improvements in submarine batteries."—A communication from Henry Doty and William Porter Downer, Rue Gaillon, Paris, France.

281. George Hammond, Manchester, and James William Kemp, Salford, Lancashire, "Improvements in the manufacture of illuminating gas, and in apparatus to be employed therein."—Petition recorded February 2, 1864.

320. Marie Celeste de Casteras Sinibaldi, South Street, Greenwich, Kent, "Improvements in the manufacture of plates, tubes, cylinders, and other articles, and for covering or coating the same with copper, brass, or other metals."—Petition recorded February 6, 1864.

351. Marie Celeste de Casteras Sinibaldi, South Street, Greenwich, Kent, "Improvements in coating with copper, brass, or other metals the surfaces of ships and other structures of iron or steel."—Petition recorded February 10, 1864.

588. Felix Spiers and Christopher Pond, Prince's Street, Cavendish Square, Middlesex, "Improvements in closing or stoppering bottles."—A communication from Barlow William Mallam, Melbourne, Victoria.—Petition recorded March 9, 1864.

834. Leonard Cooke, Horwich, Lancashire, "Improvements in the manufacture of paper."—Petition recorded April 4, 1864.

1151. Andrew Barclay, Kilmarnock, Ayrshire, N. B., "Improvements in certain apparatus for injecting and ejecting fluids."—Petition recorded May 6, 1864.

1172. Henry Aitken, Falkirk, Stirlingshire," N. B., "Improvements in the system or mode of calcining and extracting the oils and gases from ironstone and other materials, and in the apparatus or means employed therefor."—Petition recorded May 9, 1864.

1243. Richard Archibald Brooman, "Improvements in dyeing wool and other filamentous and textile materials, and in machinery employed therein."—A communication from Jean Henri Chaudet, Rouen, France.—Petition recorded May 17, 1864.

MISCELLANEOUS.

Antiasthmatic Paper.—

Leaves of belladonna	5
,, of datura stramonium	5
,, of digitalis	5
,, of sage	5
Tincture of benzoin	40
Nitrate of potash	75
Water	1000

Make a decoction of the plants, dissolve the nitrate of potash in the liquid, add the tincture of benzoin, and plunge into the liquid, leaf by leaf, a quire of red blotting-paper. After twenty-four hours withdraw the paper, let it dry, and divide it into squares ten centimetres long by seven broad, and enclose them in boxes.—*Journal de Pharmacie et de Chimie.*

Restoration of Pictures.—Professor Pettenkofer, of Munich, who, it may be remembered, has invented a method for restoring pictures, has just patented his invention in this country. The nature of the process, which has been for some time an object of much speculation, is extremely simple, and is mechanical, not chemical. The change which takes place in pictures, he says, is "the discontinuance of molecular cohesion," which "process begins on the surface with microscopical fissures in the varnish, and penetrates by-and-by through the different coats of colours to the very foundation. The surface and body of such a picture become in the course of time intimately mixed with air, and reflect light like powdered glass, or loses its transparency like oil intimately mixed with water or air." The process consists in causing these molecules to re-unite, which he does as follows:—The picture is exposed in a flat case, lined with metal, to an atmosphere saturated with vapour of alcohol at the ordinary temperature, which vapour is absorbed by the resinous particles of the picture to the point of saturation. The different separated molecules thus "re-acquire cohesion with each other, and the optical effect of the original is restored solely by self-action, the picture not getting touched at all." Other substances besides alcohol—such as wood-naphtha, ether, sulphuric and other ethers, turpentine, petroleum, benzine, &c.—may be used. The process seems to have been very successful at Munich, where Professor Pettenkofer restored some almost invisible pictures to very nearly their original freshness. Liebig has reported favourably on the method, and has given it as his opinion that it cannot injure the paintings—which, indeed, is almost a consequence of its extremely simple nature.—*Reader.*

ANSWERS TO CORRESPONDENTS.

W. A. W.—We hope to begin early in the next volume.

A Subscriber.—The patent is not yet published; but you may see it at the Patent Office in Chancery Lane.

Chlor-Kalium.—There is no "ready and simple method." You must estimate the chlorine and the potassium, and sulphuric acid if present, and combine your results in the usual way.

Book Received.—"Companion to the British Pharmacopœia," etc., etc. By P. Squire.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Separation of Cerium from Didymium and Lanthanum, by Wolcott Gibbs, *M.D., Rumford Professor in Harvard University.*

The methods which have recently been proposed for the separation of cerium from lanthanum and didymium are familiar to chemists, and do not require recapitulation in this place. They all depend, like the older methods, upon the oxidation of cerium to a sesquioxide, or to Ce_3O_4, and upon the formation of insoluble basic salts of the sesquioxide. No one of these methods effects a complete or quantitative separation, though all afford means of obtaining salts of cerium in a state of chemical purity. The following observations upon this subject are believed to be new:—

When a salt of cerium, lanthanum, and didymium is boiled with dilute nitric acid, and peroxide of lead added to the solution, the cerium is quickly, and under some circumstances completely oxidised, the solution becoming more or less deeply orange-yellow. This process affords an extremely simple and delicate test for cerium; it succeeds with all the salts which are soluble in nitric acid, though, of course, when the mixed oxalates are tested the oxalic acid is oxidised to carbonic acid before the characteristic cerium yellow appears. For the purpose of testing, it is sufficient to dissolve the salt to be examined in nitric acid, diluted with its own volume of water, to add a small quantity of pure peroxide of lead, and boil for a few minutes, when the smallest trace of cerium can be detected by the yellow colour of the solution. The reaction is here exactly analagous to that of nitric acid and peroxide of lead with solutions of manganese, which last is oxidised, not as Crum supposed, to hypermanganic acid, but, as Rose has shown, to sesquioxide.

When a solution containing a salt of cerium dissolved in strong nitric acid is boiled for a short time with a large excess of peroxide of lead, oxygen gas is copiously evolved, and at the same time the sesquioxide of cerium formed at first is completely reduced to protoxide, the solution becoming perfectly colourless. The remarkable reaction which occurs in this case appears to be connected with the formation of nitrate of lead, since, when the solution of protoxide of cerium contains a large excess of this salt, the cerium is not peroxidised by boiling with nitric acid and the peroxide.

Solutions of cerium salts are also oxidised by boiling with peroxide of lead and dilute sulphuric acid, but the protoxide of cerium, in the nearly insoluble double sulphate of soda and the cerium metals is only partially oxidised by heating with strong sulphuric acid and peroxide of lead, although oxygen is freely evolved.

A solution of hypermanganate of potash has no immediate action upon a solution of protoxide of cerium either in nitric or in sulphuric acid, the violet colour remaining unchanged even in a hot solution. On boiling for some time, however, the colour changes slowly, the solution gradually becomes yellow, and a brown flocculent precipitate is thrown down, which consists of hydrate of sesquioxide of manganese.

According to Stapff, a solution of hypermanganate of potash immediately decolorised by a solution of the sulphate of potassium and protoxide of cerium in chlorhydric acid, but after some time chlorine is evolved, and the sesquioxide of cerium found is reduced to protoxide. It is clear that in this case the oxidising agent is chlorine. The further investigation of this subject was committed to Dr. T. M. Drown, who has obtained the following results:—

When a solution of cerium, didymium, and lanthanum is treated with nitric acid and peroxide of lead in the manner pointed out above, the deep orange-coloured liquid evaporated to dryness, and heated for a short time to a temperature sufficiently high to expel a portion of the acid, it will be found that boiling water acidulated with nitric acid dissolves only the salts of lanthanum and didymium, leaving the whole of the cerium in the form of basic nitrate insoluble in water. The insoluble matter is to be filtered off and thoroughly washed. A current of sulphydric acid gas passed into the filtrate removes the lead, after which the lanthanum and didymium may be precipitated together as oxalates, which, if the process has been carefully performed, are perfectly free from cerium. The mass on the filter is readily dissolved by fuming nitric acid. Sulphydric acid is then to be passed through the solution sufficiently diluted with water until the lead is completely precipitated. The cerium may then be thrown down by oxalic acid ignited and weighed as Ce_3O_4, or as sulphate. In this manner Dr. Drown obtained in four analyses of the same salt—DiO and LnO = 24·84, 25·31, 25·54, 24·65 per cent.

Nitrate of protoxide of cerium obtained by this process gives, when tested by the spectroscope with transmitted light, even in very thick layers, a scarcely perceptible indication of didymium. I may here mention that Gladstone's lines furnish, with proper care, the most delicate test for the presence of didymium which we possess. It is only necessary to transmit the light through very thick layers of liquid, and to empty a condensing lens so as to throw the transmitted light directly upon the slit of the spectroscope.—*American Journal of Science*, vol. xxxvii. p. 352.

Researches on Affinities.—The Formation and Decomposition of Ethers, by MM. Berthelot *and* L. Pean de Saint-Gilles.

We have already given our experiments as to the limits of etherification—that is to say, the state of equilibrium, established, in time, in a determinate series with acid, alcohol, water, and neutral ether. It now seems to us useful to condense the general results of these experiments. They should be regarded from two points of view. On the one hand we may contrast the statics of etherising reactions, which require time for their development, with the statics of saline reactions, which are accomplished almost instantaneously. On the other hand we may regard the statics of etherising reactions as revealing the laws which regulate the divisions which take place in homogeneous series, and of which the study of saline reactions gives but a vague and incomplete idea.

We will now look at the subject from the first point of view.

1. Let us recall as a point of comparison some of the phenomena which occur in saline reactions. By making a soluble base act on a soluble acid, for instance, potash on acetic or sulphuric acid, 1 equivalent of potash immediately combines with 1 equivalent of acid. If the operation is performed in presence of excess of alkali or of acid, or of a certain quantity of salt which is formed, that is to say, sulphate or acetate of potash, the least abundant body, in any case, enters immediately and entirely into combination. The amount of water in presence of the acid base at the moment of combination has no effect on the result. These statements are the result of ascertained

facts, and are confirmed by the study of calorific effects which take place in saline reactions.

These phenomena characterise not only the reaction of a soluble base on a soluble acid, but likewise the action of a gaseous acid, such as hydrochloric acid on a gaseous base, such as ammonia, whether these two bodies exist either in a gaseous form or in solution. In short, the same phenomena are manifested throughout the homogeneous saline series, provided certain special conditions of insolubility or volatility capable of determining accessory phenomena by destroying the homogenousness of the series are avoided.

2. Now let us examine what takes place in etherising reactions. For instance, by inducing the reaction of ordinary alcohol on acetic acid, these two bodies being capable of admixture in any proportions, and with the products of their reaction. The two bodies combine little by little, and very slowly, and in accordance with the progressive laws set forth; but the reaction effected between 1 equivalent of acid and 1 equivalent of alcohol never attains complete combination. Long before that point the combination is arrested, because it is limited by the action of the water formed in the combination, which tends to decompose the ether already formed. This reciprocal decomposition of a neutral ether, by water in a homogeneous series, represents an order of effects quite dissimilar to those which occur in the reaction of potash on acetic acid.

3. By eliminating the water, the reaction between equal equivalents of acid and alcohol may be completed, the same as in the reaction of an acid on a base. But, under the ordinary conditions, the water intervening, etherification is arrested at a certain limit. The limit of the reaction is determined by fixed conditions; it is nearly independent of temperature and pressure, provided the series remains liquid; it is even almost independent of the state of solution in a menstruum, incapable of acting on one of the component parts of the series.

4. On the contrary, the limit of reaction is not the same in a gaseous as in a liquid system; the combination between acid and alcohol is so much the more complete as the exhaustion of the system is more considerable. In other words, the decomposing action of water on neutral ether is decreased by the expansion more rapidly than the composing action of the acid on alcohol.

5. Hitherto we have surveyed in a general way the reciprocal action of 1 equivalent of alcohol on 1 of acid. This action is modified by the presence either of an excess of acid or of alcohol, primitive components, or of an excess of water or neutral ether, products of the reaction. Nor is this all. According to the theories on etherification generally accepted before our researches, it would seem that the affinities between various acids and alcohols were not exerted in the same manner, and did not attain the same limit. There are here an entirely new set of conditions of equilibrium in the exercise of chemical affinities.

6. One fact first engages our attention. Having induced reaction with equal equivalents of various monobasic acids and monoatomic alcohols, we found that the quantity of neutral ether formed, that is to say the limit, varied very slightly, whatever might be the diversity of equivalents, volatility, or solubility, in short of properties physical and chemical, between these acids and alcohols. The proportion is always comprised between 60 and 70 hundredths, and it oscillates from $\frac{2}{3}$rds of 1 equivalent.

The same reaction extends to polyatomic bodies. In fact, the quantity of acid neutralised in the reaction of one equivalent of monobasic acid on one equivalent of polyatomic alcohol (glycerine, glycol, erythrite) is comprised within the same limits as with mono-atomic alcohol. Again, the same holds with the proportion of bibasic* or tribasic acid neutralised by a mono-atomic or polyatomic alcohol. In fact, the equivalent proportion of an acid and alcohol entering into combination, the two bodies being put in contact in equal equivalents, are almost independent of the special nature of the acid and alcohol.

We say *almost*, and not *absolutely*, because comparative experiments on metameric series—that is to say, on series ponderably identical, and the physical properties of which are as similar as possible—do not lead to exactly the same limit, but to values very nearly the same.

7. The relation thus understood is quite general; it applies not only to the case of the acid and the alcohol having equal equivalents, but it is verified also, according to our experiments, whatever the relative proportions of acid and alcohol, whatever may be their properties. This is equally true whatever quantities of water or neutral ether may be added.

Generally, in a series formed of acid, alcohol, neutral ether, and water, in whatever proportions, the limit of the reaction depends almost exclusively on the relations existing between the equivalents of these various bodies; and is almost independent of their individual nature.

The same relation determines the total limit of the reaction, not only in a series containing an acid and an alcohol, but also in a series containing several acids and alcohols. In this case the sum of the equivalents of acids are compared with the sum of the equivalents of alcohols, on the one hand, and on the other with the total quantity or limit of acid neutralised at the moment of equilibrium.

Such is the fundamental law which brings the statics of the etherene reactions of organic chemistry to the equivalents—that is to say, to the same essential datum as the saline reactions of mineral chemistry.

We will now go further into the discussion of the conditions of equilibrium determining the formation and the decomposition of ethers according to the proportions of acid, alcohol, water, and neutral ether. Here are conditions so much the more characteristic in that they apply to a division effected in the homogeneous series, which so remain during the whole of the reactions.

1. One equivalent of acid being put in contact with several equivalents of alcohol, the quantity of ether increases with the number of equivalents of alcohol, although a single equivalent only enters into the reaction. The alcohol acts quite differently to a solvent foreign to the reaction, since the latter would not sensibly modify the limit. The increase resulting from the predominance of alcohol is effected continuously and without any sudden action. The acid thus indefinitely approaches a state of complete combination, because the excess of alcohol tends to weaken the antagonistic influence of the water. Experiment shows that the quantity of uncombined acid, in presence of excess of alcohol, is nearly in inverse ratio to the total quantity of alcohol.

If, on the contrary, the amount of acid is less than one equivalent, the absolute quantity of ether formed is necessarily diminished. The quantity then tends to remain proportional to the weight of alcohol employed, from $\frac{1}{2}$ an equivalent to a very small quantity of alcohol; this explains why, during this interval, the effects of the affinities set in action during the formation of an ether

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* With some reservation relative to sulphuric acid.

have a tendency to remain proportional to the smallest of the chemical masses entering into the reaction. The proportion, however, is not absolutely fixed, for the series approaches little by little to the state of complete etherification of the alcohol in proportion as it tends to become null in the series. In other words, a trace of alcohol, in presence of an acid, etherifies, so to speak, entirely.

Polybasic acids and polyatomic alcohols behave under all these circumstances exactly the same as mono-atomic alcohols.

The foregoing statements apply to all possible mixtures of pure alcohol and pure acid; but they are more especially intended to evidence the influence of alcohol on etherification.

To exemplify the influence of acid on the same series of reactions, an inverse point of view must be taken.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 6.

"*On the Metal Indium and Recent Discoveries in Spectrum Analysis*," *by Professor* Roscoe, *F.R.S.*

Since the spring of 1862, when the speaker delivered a course of three lectures in this institution on the spectrum discoveries, much has been done to increase our knowledge of spectrum analysis, but the whole subject is still in its infancy, and the further we advance the more we find remains to be known.

No less than four new elementary bodies have already been discovered by means of spectrum analysis: cæsium and rubidium, by Bunsen; thallium, by Crookes; and indium, by Reich and Richter, of Freiberg; whilst the foundations of solar chemistry, laid by Kirchhoff, have been rendered more secure by the observations of Cooke, in America; Donati, in Italy; and Miller and Huggins, in England.

Cæsium and rubidium were at first only found in one or two mineral waters; they have since been shown to be widely distributed in the vegetable as well as in the mineral kingdom; they have been obtained in considerable quantities from the beet-root salt, and found in the ashes of tea and coffee, thus proving that they occur commonly in soil; whilst, quite recently, M. Pisani has found that a mineral, called pollux, occurring in Elba, contains 34 per cent. of cæsium, this metal having been mistaken for potash in the analyses which had previously been made of this substance. Thallium and its compounds have been obtained in large quantities, and their properties fully investigated by Crookes and Lamy, whilst this metal has not only been found in iron pyrites, but also in large quantities by Schrötter in the mica of Zinnwald, and in lepidolite from Moravia. Thallium has been shown by Boettger to occur together with cæsium and rubidium in the mineral water of Nauheim, near Frankfort; Boettger has, moreover, shown that thallium is contained in the vegetable kingdom, he has found it in the yeast of the vinous fermentation; so that thallium exists in wine; also in treacle, tobacco, and chicory. If 4 lbs. of any of these substances are employed, a sufficient quantity of thallium can be obtained as the double platinum chloride to enable its presence to be easily detected. Professor Bunsen has informed the speaker that he has found a mother liquor from the Hartz, which contains so much thallium that the iodide can be obtained by direct precipitation in quantity at the rate of 10s. per lb. The speaker exhibited the spectrum of the Nauheim salt, which contains the three new elements; the spectrum of each metal is well seen by placing the mixed platino-chlorides in the electric arc.

Drs. Reich and Richter, of Freiberg, in Saxony, have lately discovered a fourth new metal in the Freiberg zinc blende.* This metal has been termed indium, from the two splendid indigo-blue lines which characterise its spectrum. Through the kindness of Professor Richter, the speaker had been placed in possession of a few grains of this new metal, the spectrum of which was exhibited by the electric lamp. In its chemical relations it resembles zinc, with which it is associated in nature; the metal can be reduced before the blowpipe to a malleable bead, when it forms a soft, ductile bead, which imparts streaks to paper on rubbing, and possesses a colour lighter than that of lead, being about the same as that of tin. The metallic bead dissolves in hydrochloric acid, with the evolution of hydrogen. The oxide of indium is formed as a yellow fusible incrustation when the metal is heated before the blowpipe on charcoal. Indium differs from zinc in the insolubility of the hydrated oxide in excess of both ammonia and caustic potash. This new element may be separated from all the known metals by precipitating its sulphide in alkaline solution, and by throwing down the hydrated oxide, first with ammonia and then with caustic potash; and, lastly, by precipitating the iron with dilute solution of bicarbonate of sodium. The hydrated oxide of indium then remains in solution in the pure state. Indium may be readily detected when present in its pure compounds by the deep purple tint which these impart to flame. The characteristic lines are, however, best seen when a small bead of indium salt is placed between two poles, from which an electric spark passes; the lines In α and In β fall respectively upon divisions 107·5, and 140 of the photographic scale of the spectroscope, when $\mathrm{Na} = 50$, and $\mathrm{Sr}\ \delta = 100{\cdot}5$. Up to the present time indium has been only found in the very smallest quantity, and hence the atomic weight of the metal and the composition of its salts have not yet been determined; in fact, the speaker was led to infer that Professor Richter sent him nearly all the compound of the metal remaining from the investigation of its properties, for the purpose of illustrating this discourse. It has only as yet been detected in the zinc blende of Freiberg; but it will, doubtless, soon be discovered in larger quantities, and its compounds more closely studied.

As regards the spectra of the well-known metals, our knowledge has been much increased by the publication of the second series of Kirchhoff's maps of the solar spectrum and the spectra of the chemical elements (Macmillan and Co.). In these Kirchhoff has marked the position of the bright lines of no less than thirty metals, and indicated those which, as they coincide with a dark solar line, reveal the presence of the particular metal in the sun's atmosphere. Kirchhoff's maps now embrace the whole of the visible spectrum from the line A in the extreme red to the line G in the indigo; beyond these limits the intensity of the light passing through his three prisms became too slight to enable him to draw the lines. The observations thus made of coincidences of metallic with solar lines in the red and indigo portions of the spectrum, confirm the conclusions drawn by Kirchhoff from his earlier observations, with the exception of the presence of potassium. This metal is not seen in the solar atmosphere, the potassium red line is not coincident with the solar A, as it was supposed to be, nor with any other dark solar line. No metal, in addition to those previously observed, was found to possess lines coincident with solar lines, and hence the number of bodies known to be present in the sun has not been increased.

The experiments of Mr. Huggins on the spectra of the metallic elements, made with an instrument of six prisms, although not yet published in full, promise to add greatly to our knowledge on this subject; one interesting observation may be cited, viz.: that the spectrum of sodium has been found to contain three pairs of lines in addition to those corresponding to the dark double

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* *Phil. Mag.* for March, 1864. Series 4, vol. xxvii. p. 199.

line D, and that these also coincide with dark solar lines, adding to the evidence previously possessed of the existence of sodium in the sun. The audience had been already made acquainted with Dr. Miller's important researches on the photographic spectra of the metals, and with the valuable observations made by himself and Mr. Huggins on the spectra of the fixed stars. Connected with this part of the subject may be mentioned Professor Stokes's interesting investigation on the long spectrum of the electric spark, in which he shows that the vapour of certain metals, such as iron and magnesium, when heated by the passage of an electric spark, emit rays of so high a degree of refrangibility that they are situated at a distance from the lines H, ten times as great as that of the whole visible spectrum from A to H. These highly refrangible rays only become visible at the highest temperatures, and they are not seen in the solar spectrum, although the less refrangible iron and magnesium lines are present. Hence it has been suggested that the temperature of the sun must be lower than that of the electric spark in which these lines are developed. This conclusion appears legitimate only if we know that these rays of high refrangibility are not absorbed in passing through our atmosphere; and an investigation of great interest here presents itself for those who ascend into the higher regions of the atmosphere.

The observations of Dr. Robinson upon metallic spectra have led this astronomer to doubt the validity of some of the conclusions arrived at by Kirchhoff concerning the existence of a separate and non-coincident set of lines in the spectrum of each metal. It seems, however, that Dr. Robinson employed only one prism and a low magnifying power, so that we must conclude that the observations from which he deduces the coincidence of certain lines as proving their identity in several metals, cannot impugn the results obtained by help of a larger instrument of sufficient power to resolve these apparent coincidences.

The original statement made by Bunsen and Kirchhoff concerning the spectra of the metals still remains unopposed by a single well-established fact—the statement namely, that when a metal is heated up to a certain point, the spectrum of its incandescent vapour contains a number of fine bright lines which do not change their position with increase of temperature, and are not coincident with the lines of any other known substance. There is, however, no doubt of the fact that in the spectra of certain metals or metallic compounds new lines are developed by increase of temperature; and also that certain metals, as calcium, barium, and strontium, yield spectra of two kinds; one of these, seen at the lower temperature, and consisting of broad bands, being resolved at a higher temperature into bright lines. These bright lines do not undergo any further change on elevation of temperature, and characterise the true metallic spectrum, whilst the band-spectrum is probably produced by the incandescent vapour of a metallic compound which is decomposed at a higher temperature.

Our knowledge of the spectra of the non-metallic elements is, as yet, in a very incomplete state. To the researches of Plücker we are especially indebted for information on this subject; he has shown that each metalloid possesses a peculiar and characteristic spectrum; hydrogen, for instance, yielding only three bright lines, all of which are coincident with dark solar lines; and nitrogen exhibiting a complicated series of bands. Plücker has lately come to the conclusion that many non-metallic elementary bodies, and among them sulphur and nitrogen, exhibit two distinctly different spectra when the temperature is altered, in this respect resembling the metals of the alkaline earths. This difference Plücker ascribes to the existence of these elements in two allotropic conditions.

A singular relation with regard to what have been termed the carbon lines was observed by the speaker. It has been stated that all the various forms of carbon compounds when in the state of incandescent gas, yield identical spectra. This proves not to be the case; the spectrum obtained from the flame of olefiant gas is different from that obtained by the electric discharge through a vacuum of the same gas; whilst the spark passing through a cyanogen vacuum produces a spectrum identical with that of the olefiant gas-flame, and through the carbonic oxide vacuum a spectrum coincident with that of the spark through olefiant gas vacuum.

As an illustration of the application of abstract scientific principles to useful practical purposes, the speaker stated that he had lately applied spectrum analysis to the manufacture of steel by the Bessemer process. One of the great drawbacks to the successful practical working of Mr. Bessemer's beautiful process for converting cast-iron directly into steel has been the difficulty of determining the exact point at which the blast of air passing through the molten metal is to be stopped. The conversion of five tons of cast-iron into cast-steel usually occupies from fifteen to twenty minutes, according to the varying conditions of weather, quality of the iron, strength of the blast, &c. If the blast be continued for ten seconds after the proper point has been attained, or if it be discontinued ten seconds before that point is reached, the charge becomes either so viscid that it cannot be poured from the converting vessel into the moulds, or it contains so much carbon as to crumble under the hammer. Up to the present time, the manufacturer has judged of the condition of the metal by the general appearance of the flame which issues from the mouth of the converting vessel. Long experience enables the workman thus to detect, with more or less exactitude, the point at which the blast must be cut off. It appeared to the speaker that an examination of the spectrum of this flame might render it possible to determine this point with scientific accuracy, and that thus an insight might be gained into the somewhat complicated chemical changes which occur in this conversion of cast-iron into steel. At the request of Messrs. John Brown and Co., of the Atlas Works, Sheffield, the speaker investigated the subject, and succeeded in obtaining very satisfactory and interesting results. The instrument employed was an ordinary Steinheil's spectroscope, furnished with photographic scale and lamp, and provided with a convenient arrangement for directing the tube carrying the slit towards any wished-for part of the flame, and for clamping the whole instrument in the required position. By help of such an arrangement the spectrum of the flame can be most readily observed, and the changes which periodically occur can be most accurately noted.

The light which is given off by the flame in this process is most intense; indeed, a more magnificent example of combustion in oxygen cannot be imagined; and a cursory examination of the flame-spectrum in its various phases reveals complicated masses of dark absorption bands and bright lines, showing that a variety of substances are present in the flame in the state of incandescent gas. By a simultaneous comparison of these lines in the flame-spectrum with the well-known spectra of certain elementary bodies, the speaker has succeeded in detecting the presence of the following substances in the Bessemer flame:—Sodium, potassium, lithium, iron, carbon, phosphorus, hydrogen, and nitrogen.

A further investigation with an instrument of higher dispersive and magnifying powers than that employed will doubtless add to the above list; and an accurate and prolonged study of this spectrum will probably yield very important information respecting the nature of the reactions occurring within the vessel. Already the investigation is so far advanced that the point in the condition of the metal at which it has been found necessary to stop the blast can be ascertained with precision; and thus, by the application of the principles of spectrum analysis, that which previously depended on the quickness of vision of a skilled eye has become a matter of exact scientific observation.

Another interesting practical application of our knowledge concerning the properties of the kind of light which certain bodies emit when heated is the employment of the light evolved by burning magnesium wire for photographic purposes. The spectrum of this light is exceedingly rich in violet and ultra-violet rays, due partly to the incandescent vapour of magnesium, and partly to the intensely-heated magnesia formed by the combustion. Professor Bunsen and the speaker in 1859 determined the chemically active power possessed by this light, and compared it with that of the sun; and they suggested the application of this light for the purpose of photography. They showed[†] that a burning surface of magnesium wire, which, seen from a point at the sea's level, has an apparent magnitude equal to that of the sun, effects on that point the same chemical action as the sun would do if shining from a cloudless sky at a height of 9° 53′ above the horizon. On comparing the visible brightness of these two sources of light, it was found that the brightness of the sun's disc, as measured by the eye, is 524·7 times as great as that of burning magnesium wire when the sun's zenith distance is 67° 22′; whilst at the same zenith distance the sun's chemical brightness is only 36·6 times as great. Hence the value of this light as a source of the chemically active rays for photographic purposes becomes at once apparent.

Professor Bunsen and the speaker state in the memoir above referred to that "the steady and equable light evolved by magnesium wire, burning in the air, and the immense chemical action thus produced, render this source of light valuable as a simple means of obtaining a given amount of chemical illumination, and that the combustion of this metal constitutes so definite and simple a source of light for the purpose of photo-chemical measurement that the wide distribution of magnesium becomes desirable. The application of this metal as a source of light may even become of technical importance. A burning magnesium wire of the thickness of 0·297 millimetre evolves, according to the measurement we have made, as much light as 74 stearine candles, of which five go to the pound. If this lighted lasted one minute, 0·987 metre of wire, weighing 0·120 grammes, would be burnt. In order to produce a light equal to 74 candles burning for ten hours, whereby about 20 lbs. of stearine is consumed, 72·2 grammes (2½ ounces) of magnesium would be required. The magnesium wire can be easily prepared by forcing out the metal from a heated steel press having a fine opening at bottom; this wire might be rolled up in coils on a spindle, which could be made to revolve by clockwork, and thus the end of the wire, guided by passing through a groove or between rollers, could be continually pushed forward into a gas or spirit lamp flame in which it would burn."

It afforded the speaker great pleasure to state that the foregoing suggestion had now been actually carried out. Mr. Edward Sonstadt has succeeded in preparing magnesium on the large scale, and great credit is due to this gentleman for the able manner in which he has brought the difficult subject of the metallurgy of magnesium to its present very satisfactory position.

Some fine specimens of crude and distilled magnesium weighing 3 lbs. were exhibited, as manufactured by Mr. Sonstadt's process, by Messrs. Mellor and Co., of Manchester.

The wire is now to be had at the comparatively low rate of 3d. per foot,[‡] and half an inch of the wire evolves on burning light enough to transfer a positive image to a dry collodion plate, whilst by the combustion of 10 grains a perfect photographic portrait may be taken, so that the speaker believed that for photographic purposes alone the magnesium light will prove most important. The photo-chemical power of the light was illustrated by taking a portrait during the discourse. In doing this the speaker was aided by Mr. Brothers, photographer, of Manchester, who was the first to use the light for portraiture.

ACADEMY OF SCIENCES.

June 13.

A memoir by M. Wurtz announces that he has formed hexylene by the action of sodium on the dihydriodate of diallyl. Several other hydrocarbons with high boiling points were formed at the same time. Hexylene distils between 68° and 70°; another hydrocarbon, $C_{12}H_{22}$, formed in the reaction, distilled between 190° and 200°.

M. V. de Luynes presented a memoir "*On the Hydriodate and Hydrate of Butylene,*" which he describes as isomeric with the iodide and hydrate of butyle.

The French chemists are still busy with various theories and experiments on fermentatton. Two notes read at the last meeting were on this subject, but offer nothing to report.

M. Lefort claims priority of discovery in the method of separating digitaline by dialysis, alluded to last week. He deposited a sealed paper with the Academy some time ago describing the process and some reactions of digitaline. Some remarks on different kinds of digitaline in use in France we shall append to the paper of M. Grandeau, which we shall shortly publish.

NOTICES OF BOOKS.

Annalen der Chemie und der Pharmacie. May, 1864.

Most of the papers in this Journal relate to organic chemistry, and are of little general interest. They include Researches on the Uric Acid Group, by A. Baeyer; a second communication on Menthol, by A. Oppenheim; a paper on Acrolein-ammonia, and a new base obtained from it by distillation by Dr. Claus; some observations on Tartramide and Tartramimic Acid, by K. Grote, who also gives an analysis of Cystin, and some remarks on Azelic Acid. To cystin this author assigns the formula $C_6H_7NS_2O_4$, that is, one more atom of hydrogen than former experimenters found. Erdmann describes a new basis from Valeral-ammonia, and Strecker some compounds of Valeraldehyd. Schoyen communicates a method of obtaining butyric acid by synthesis, and Beilstein a paper on reduction of nitro-bodies by tin and hydrochloric acid. Among the articles to which we may return is one on the quantitative estimation of uric acid by Heintz, and another on the purification of arsenical sulphuric acid by Buchner, who removes arsenious acid by passing chlorine through hot sulphuric acid. Should arsenic acid be present, he reduces this to arsenious acid by heating the sulphuric with a piece or two of charcoal, and then passes the chlorine; the two operations may be conducted simultaneously. Natanson gives a very delicate test for protosalts of iron, which consists in adding a solution of rhodianate potash to the iron solution, and then shaking it up with a little ether. The ether becomes rose-coloured or blood red according to the amount of iron. Fehling makes known that he has found a crystallised double carbonate of soda and potash—

$$KO,NaO,C_2O_4+12HO.$$

This salt was obtained from a saltpetre manufactory, and also from a prussiate of potash factory.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following paper will be read:—"On the Philosophy of Agriculture," by Mr. J. T. Way.

[†] Phil. Trans. 1859, p. 920.

From Messrs. Johnson and Matthey, of Hatton Garden.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, Patent Agent, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

357. Jean Marius Faget, Bordeaux, France, "Improved apparatus for taking up the emanations and the gases from boilers.—Petition recorded February 11, 1864.

1310. John Harcourt Brown, Strand, Westminster, "Improvements in treating animal substances for the manufacture of size, pulp, and pulpy matter, and converting the said pulp or pulpy matter into sheets, slabs, blocks, thread, hollow or tubular articles, and such other articles of commerce for which the said sheets, slabs, blocks, threads, hollow or tubular articles may be applicable."—Petition recorded May 26, 1864.

Notices to Proceed.

280. John Hawkins, Walsall, Staffordshire, and Charles Hawkins, Selly Oak, Worcestershire, "Improvements in the manufacture of gas for illumination and other purposes, and in apparatus connected with the same."—Petition recorded February 2, 1864.

299. James Young, Bucklersbury, London, "Improvements in the preservation of vegetable and animal matters."—Petition recorded February 4, 1864.

301. Eugen Lucius, Frankfort-on-the-Maine, Germany, "Improvements in the separation and purification of colours."

307. Robert Owen, Manchester, Lancashire, "Improvements in apparatus for filtering water and other liquids."—Petitions recorded February 5, 1864.

340. William Clark, Chancery Lane, Middlesex, "Improvements in apparatus for inhaling air when charged with vapours."—A communication from Charles Pierre Baillemont, Boulevard St. Martin, Paris.

341. Brereton Todd, Falmouth, Cornwall, "Improvements in compositions to be used to prevent the oxidation of iron, the fouling of ships' bottoms, and other submerged things, and also preserving wood from decay and worms."

342. Angier March Perkins, Francis Street, Regent's Square, Middlesex, "Improvements in warming rooms and buildings."

346. Peter Spence, Newton Heath, Lancashire, "Improvements in the manufacture of sulpho-cyanide of ammonium and other sulpho-cyanides."—Petitions recorded February 9, 1864.

403. James Wadsworth, Heaton Norris, Lancashire, "Improvements in the methods of softening or dissolving bone, horn, hair, leather, curriers' shavings, raw hide scraps, wool, woollen rags, or other animal matters."—Petition recorded February 17, 1864.

621. Hugh Simester, New Street, Dorset Square, and John Bainbridge, Ely Place, Middlesex, "Improvements in register stoves or fireplaces and furnaces conducing to the consumption of smoke, and applicable to warming, ventilating, cooking, and other purposes."—Petition recorded March 12, 1864.

1325. John William Lees, Waterhead Mill, near Oldham, Lancashire, "Certain improvements in the method of cleaning and preventing the formation of deposits upon the heating apparatus employed in boilers for generating steam."—Petition recorded May 28, 1864.

CORRESPONDENCE.

The Silicates of Thallium and Alkalies.

To the Editor of the Chemical News.

Sir,—Having from time to time taken much interest in the researches into the uses and properties of thallium which have appeared in the Chemical News, I have often thought of suggesting an investigation into the silicates of thallium compounds, of which I have hitherto seen no notice or hint in any publication.

It would be very interesting, and probably of practical importance, to ascertain how far its properties are available for producing new tints in glass staining, &c. But what would make the subject of more immediate interest to me would be to learn the behaviour of the soluble salts of thallium with pure solutions of the alkaline silicates, and the re-solution of the gelatinous precipitates in the concentrated solutions of silicates of soda, &c.

The solubility of the gelatinous precipitates of all silicates in solutions of the alkaline silicates I claim as a discovery of my own, and with the greater confidence as there is no hint in the investigations of Fuchs and of Khallmar of this property; no mention of it in the Chemical News, except in connection with my invention; no mention of it in Dr. Percy's lectures, now appearing in your publication; no recognition of it in Liebig's "Agricultural Chemistry," although the explanation of the structure of rocks must be imperfect without a recognition of it, and agricultural chemistry necessarily modified in accordance with it.

If the subject be of that importance which I deem it to be, the insertion of these few lines in the Chemical News will, no doubt, soon set those who are most competent in the field of science to pursue the investigation both in its practical and scientific bearing. I am, &c.

Henry Ellis.

Bangor, June 18.

[We believe it is a well-known and obvious fact that gelatinous silica will dissolve in an alkaline silicate. —Ed. *C. N.*]

ANSWERS TO CORRESPONDENTS.

⁂ *We have the pleasure of informing our readers that we have made arrangements with an eminent scientific writer to supply the* Chemical News *with a weekly letter from Paris, which will contain all the Continental scientific news down to within a day or two of publication. Besides being acquainted with most of the Parisian* savans, *the writer in question has peculiar facilities for obtaining scientific information, being connected, in a literary capacity, with two of the leading scientific journals of Europe. The first letter will appear in our next number, commencing Vol. X. We shall at the same time commence a series of Lectures by Professor Wurtz, delivered before a popular audience. In these will be found a clear and original exposition of the principles of chemical science. Dr. Crace Calvert's Cantor Lectures are being rewritten for the* Chemical News *by the author, and will be commenced early in the volume.*

In our notices of books we shall greatly enlarge the plan we have recently adopted of giving a resumé *of the contents of foreign journals, so as to lay before our readers an analysis of the contents of the leading scientific journals in Europe as they appear.*

Arrangements are also being made by which we shall publish a greater number of original articles in scientific, technical, and pharmaceutical chemistry, and in physical science.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

T. N.—Your questions shall receive an answer next week.

Studiosus.—Received. Shall appear next week.

Sodium.—It is soluble to any extent. An excess of alkali favours the solution.

J. Austin.—We know no better way.

G. M.—1. Use soda ash. 2. Apply to Mr. Harrison, bookseller, Pall-mall, London.

R. L. S.—1. The reference to the original is given at page 66, but the essay is now published in a separate form, and may be had of a French bookseller. 2. We are unable to give you more information on this matter. You will no doubt find an abstract of the paper in the Proceedings of the Belgian Academy.

Received.—R. Warington.

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